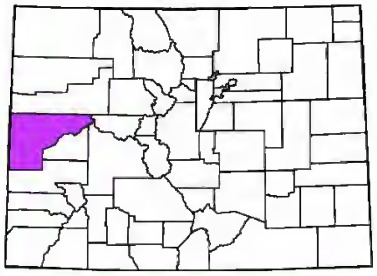
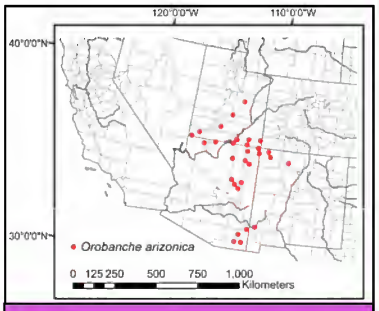
Aquilegia

Newsletter of the Colorado Native Plant Society
Volume 43 No. 2 Spring 2019

Arizona broomrape, *Orobanche arizonica* (Orobanchaceae). *Orobanche arizonica* has recently been taxonomically separated from *O. cooperi* by Turner Collins and colleagues (Collins, L.T. and G. Yatskievych. (2015) *Orobanche arizonica* sp. nov. and nomenclatural changes in *Orobanche cooperi* (Orobanchaceae). *Phytoneuron* 48: 1-19). Several characteristics distinguish *O. arizonica* from other *Orobanche spp.* including morphology (smaller inflorescence), habitat (higher elevations of pinyon-juniper woodland or desert-shrub associations), and host interactions (primarily *Gutierrezia* species). Most populations of these plants are found north of the Mogollon Rim in the four-corner region of the Colorado Plateau in contrast to similar *Orobanche* species found mostly in the Sonoran Desert. *KA*



New location of *Orobanche arizonica*



Herbarium specimen locations of *O. arizonica* (Collins and Yatskievych, 2015)

Botanicum absurdum by Rob Pudim

© Rob Pudim

PHOTO CREDITS: FRONT COVER AND INSIDE FRONT COVER: *Orobanche arizonica,* Arizona broomrape. © Jim Pisarowicz

Aquilegia Observes Plant Names per *Flora of Colorado*

Just as this publication has a style sheet to help maintain some level of consistency in formatting and editorial style from issue to issue, *Aquilegia* also adheres to the botanical Latin plant names used in *Flora of Colorado* (Jennifer Ackerfield, 2015).

While common names might vary from region to region, binomial Latin names provide a common starting point to guide a conversation about a particular native plant. *Flora of Colorado* provides the most current Angiosperm Phylogeny Group III system standards, sorting taxa into the most recent family frameworks.

Aquilegia: Newsletter of the Colorado Native Plant Society

Dedicated to furthering the knowledge, appreciation, and conservation of native plants and habitats of Colorado through education, stewardship, and advocacy

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Featured Story

Gardening to Attract Hummingbirds in Colorado

By Marcella Fremgen and Sheryl Radovich

No matter how much space you have in your yard, you can create a great space for hummingbirds! The key to a good hummingbird garden is to incorporate diversity: this will encourage hummingbirds to be there all summer if plants flower at different times throughout the season. Effective hummingbird gardens can attract birds year after year as they learn to find the best resources in the neighborhood.

Ideas for designing a hummingbird garden include:

● Cluster colorful blooms together to make the patch more visible. Keep flowers of the same color together in the same area of the garden to improve visibility to passing hummingbirds. Plant patches of the same species together to provide greater quantities of nectar.

● Layer blooms so that small plants are in the front, middle-sized plants are in the middle, and tall plants are in the back or center of the garden. This makes it easier for hummingbirds to access all the flowers. Consider including vertical structures like trellises, trees, window boxes, tubs, and pots to create a terraced effect.

Fireweed (*Chamerion angustifolium*) is found all over the Western Slope and is common above 5,300' on the Front Range. © Marlene Borneman

Skyrocket, or scarlet gilia, (*Ipomopsis aggregata*) features a reddish tubular flower that beckons hummingbirds. It grows in much of Colorado from 5,100-10,500' with the exception of the far eastern plains. © Marlene Borneman

● Narrow gardens are better because hummingbirds can access the garden from either side. Curving flower beds are a good alternative because the shape makes it easier for hummingbirds to maintain their territories.

● Create areas with both sun and shade by providing gardens both in treed and open areas. Shady areas with perches are great spots for hummingbirds to rest and digest their nectar meals. Shady areas also tend to have more insects, which are an important source of protein.

● Hummingbirds are attracted to colorful flowers and often to those with a tubular shape. Red is the most attractive color to most species of hummingbirds, but pink and orange are also enticing. Yellow and white blooms are less attractive than other colors. Red, non-

"Hummingbirds…" *continued on page32* ►

Featured Story

Arizona Broomrape Found in Western Colorado

By Jim Pisarowicz

The following is Jim's first-person account of finding a plant that was previously thought not to occur in Colorado. He found the Arizona broomrape in spring of 2018. MM

I usually begin most days, early in the morning, generally just a bit before sunrise, hiking through forests, prairies, wetlands, or wherever I happen to be, looking for plants to photograph. Mostly I do this by myself as it seems that most people are not inclined to be up early in the morning, or wanting to go walking around with their eyes focused on the ground. I have been doing this for over 30 years and find it enjoyable, rewarding, and relaxing at the same time.

So I was somewhat excited last April when I received an email from Tom Zeiner saying that he was planning on visiting the Western Slope to look for spring wildflowers. I had not met Tom before and he asked if I could suggest some places between Grand Junction, where he was planning on staying, and Montrose—where I live—to search. I quickly pointed him to Echo Canyon in the Colorado National Monument, the Unaweep Canyon and Seep area, Escalante Canyon in the Dominguez-Escalante Canyon National Conservation Area, the Gunnison Gorge National Conservation Area, and Black Canyon of the Gunnison National Park.

A closeup of the *Orobanche arizonica* flower. See the cover of this issue for a photo of the entire plant. © Jim Pisarowicz

Tom said he was going to be in the area for a couple of days and maybe we could get together. I was game for this, as it would be nice to have another interested party for my morning sojourns. I met up with Tom on his second day on the Western Slope. I suggested that we rendezvous at the turn off to Escalante Canyon just off Highway 50 north of Delta, early in the morning on Thursday, April 26.

That Thursday, I met up with Tom. We left my truck at the parking area and we car-pooled down into the canyon in Tom's Subaru. I had been into the area the previous week and suggested that we drive out to the Potholes area to begin our wildflower search.

It was a very successful morning and we located and identified many species. I photographed a dozen of these:

- Sand verbena (*Abronia fragrans*)
- Roughseed cryptantha (*Oreocarya flavoculata*)
- Plains stoneseed (*Lithospermum incisum*)
- Mountain pepperweed (*Lepidium montanum*)
- Narrow leaf yucca (*Yucca angustissima*)
- Wooly plantain (*Plantago patagonica*)
- Smallflower fishhook cactus (*Sclerocactus parviflorus*)
- Woolly locoweed (*Astragalus mollissimus*)
- Moffatt's beardtongue (*Penstemon moffatii*)
- Cliff fendlerbush (*Fendlera rupicola*)
- Pallid milkweed (*Asclepias cryptoceras*)

After a successful morning search, we began working our way back to Tom's vehicle. Along the way I spotted a plant which I could not immediately identify. I called Tom over to look at the plant to see if it was something that he could identify. Tom said that he did not know the plant. I indicated that I thought it looked like some kind of broomrape (*Orobanche*) and he concurred. I then took a couple of minutes to shoot several pictures of the unknown plant, walked back to Tom's car, and we then headed to Delta for lunch.

While driving to Delta our conversation revolved around our unidentified plant. Neither one of us had a copy of Ackerfield's *Flora of Colorado* with us. I said to Tom that when I got home, I would use the pictures that I had taken to identify the plant and I would email him copies of the pictures.

At home, I began to process the pictures I had taken, confirmed our identifications of other plants, and ►

◄ checked scientific names of the plants on our list. After an hour or so of that, I began looking more closely at the unknown broomrape.

I usually do not key wildflowers in the field as I am more interested in getting good pictures. I shoot photos of the plant's identifying characteristics so that if I cannot identify the plant by looking at pictures in field guides, I can turn to a key to figure out a positive identification.

In this case, although I had extensive pictures, I could not identify the plant after going through all of my field guides. I then turned to *Flora of Colorado*'s *Orobanche* section, but still could not confirm an identification. Ackerfield lists five different broomrapes and I googled each of these to view online pictures of each. Even doing that, I could not find a good match to the plant Tom and I had found earlier in the day.

My online search eventually led me to Al Schneider's Southwest Colorado Wildflowers website (http://www.swcoloradowildflowers.com). There I noticed a posting for *Orobanche arizonica* or Arizona broomrape. Comparing that picture of *O. arizonica* to my pictures from earlier in the day, I decided our morning broomrape was *O. arizonica*. I emailed my pictures from our morning excursion to Tom, along with my identification of the morning's broomrape.

On May 4, 2018, Tom sent this message to professor emeritus Turner Collins at Evangel University (Springfield, Mo). Dr. Turner is an expert on *O. arizonica*:

> "A friend and I were botanizing in Escalante Canyon, Colorado, on the Uncompahgre Plateau, Mesa County. We found one plant of what appears to be *Orobanche arizonica*. We couldn't place it in any other Colorado *Orobanches*, but thought we'd turn to you for an opinion. My friend, Jim Pisarowicz, is the better photographer if you'd like other images. There were no obvious host plants, but it's early so maybe they hadn't come out of dormancy yet.
>
> Any thoughts would be appreciated!"

On May 13, 2018, Tom got this reply back from Dr. Collins:

> "Looks like the real thing! If there was *Gutierriezia* (snakeweed) around, that would be the host; rarely found on anything else. Nearly all of these SW desert *Orobanches* parasitize perennial hosts. This is probably a small range extension. The total range is not yet documented. Interesting morphological variant in the corolla you focused on: it has six petals, 3 upper and 3 lower, unusual. Check out the other plants/photos and see if this is the only one. If you have duplicate specimens to share, send one to George Yatskievych at the University of Texas Herbarium. I am working with him as we continue our work on *Orobanche*. Thanks for the photo and the contact."

"... Looks like the real thing! ... The total range is not yet documented."

The next week I returned to Escalante Canyon to relocate the *O. arizonica* I found the plant but there were no other plants nearby that would have been the host for this broomrape.

On January 16, 2019, I was again back in Escalante Canyon and decided to see if I could re-find the *O. arizonica* that Tom and I had found last year. With some searching I found that plant and—unlike last year—there were two snakeweed plants nearby: the host plants.

Jen Ackerfield says she will add Arizona broomrape (*Orobanche arizonica*) to the second edition of *Flora of Colorado*.

Jim Pisarowicz is a photographer and naturalist living in Montrose, Colorado. He has shot thousands of native species to date, amassing a photographic library of over 200,000 images.

Jim is a former park ranger, college professor, and world-class cave explorer, and was the executive director of the Death Valley Natural History Association. He is a fellow of The Explorers Club, and current president of the Alpine Photography Club. Jim is also a co-president of the CoNPS Plateau chapter.

His photos have appeared in US News & World Reports, Time, New Scientist, Weekly Reader, *and various other publications, textbooks, and field guides. Jim says, "I see the beauty of plants no matter what the season."*

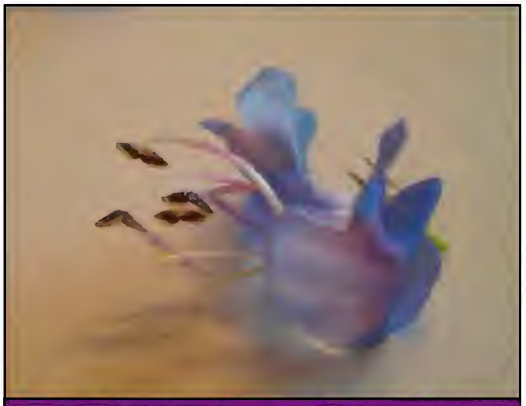
Featured Story

A Penstemon Primer

By Mike Kintgen

Few genera are as synonymous with Western North America as penstemons or beardtongues. The genus is almost entirely native only to North America with the center of diversity falling west of the 100th meridian. Over 250 species are found in North America with one outlier in Japan. The outlier is often placed in its own genus. Penstemons are native to every state in the union except Hawaii and almost every Canadian province besides Nunavut. The genus is widespread in Mexico and found in Guatemala as well. To my knowledge, it is not native to any of the Caribbean Islands.

Luckily for native plant lovers, diversity is centered in Utah and Western Colorado. Utah is home to almost 80 species and Colorado has more than 50 species. This means that most of them make excellent garden plants in Colorado.



***Penstemon saxosorum* (upland beardtongue) flower showing anthers. © Mike Kintgen**

The Evolution of Penstemons

Penstemons are now placed in the Plantaginaceae (plantago) family. Genetic work discovered that they are more closely allied to those "weeds" found in compacted moist lawns and along trails than old world *Verbascum* (mullens) and the somewhat similar looking *Scrophularia* (figworts).

All penstemons have a tubular flower, which is why they were placed in the Scrophulariaceae family for more than 100 years. The tube can vary in length and color. The flowers are zygomorphic and bilabiate, meaning there are three lobes on the bottom of the tube and only two lobes at the top. Both the Latin name *Penstemon* and the common name beardtongue refer to a fifth sterile stamen. This stamen is called the staminode and does not produce any pollen. This staminode can have hairs on it giving it the appearance of a small woolly caterpillar.

How the four fertile stamens dehisce (open) to release pollen has been used to differentiate closely-related species in the past. Examining how they open often requires a hand lens. Most species can be easily identified by their general appearance and habitat. In fact, habitat and range are strong clues to identify penstemons in the wild. Part of the reason there are so many species of penstemon is they have rapidly evolved in response to the multitude of habitat and microclimates in the Western US. Many species are rather closely related, but geographic isolation has allowed them to speciate or evolve into new species.

Penstemon have been evolving to occupy almost every elevation and habitat in Colorado and the West. You will encounter penstemons from the plains to the peaks of the highest mountains. The only habitats that they have been unable to truly conquer are aquatic habitats and deep dark shade in the forest.

The diversity of habitats and elevations is a win-win for gardeners. It means that regardless of growing conditions, there are at least a few species of penstemon suitable for your garden that will not need supplemental irrigation or amended soils.

Are there any downsides to penstemons? Perhaps the only downside is that most penstemons are short-lived. Many species are pioneer plants by choice, colonizing recently disturbed areas such as landslides, burned areas, roadsides, and pipeline scars.

Great Places to see Penstemons

Living in Colorado means that several to many species are a short drive from home.

Starting near the northeast corner of the state, Pawnee Buttes is a great place to see *Penstemon angustifolius* and possibly *P. eriantheris*, though I have never seen it there. Mid- to late-May is the best time to view penstemons in flower. Also found in the Pawnee Buttes area is *P. ambiguus*, the most non-penstemon-like of our native species. It is found in the sand areas of the eastern Plains, in the eastern two tiers of counties.

Moving toward the southeast corner of Colorado—the area from Pueblo to the Kansas state line—is home to several species. The bluff natural area west of Pueblo is good for *P. angustifolius* var. *caudatus*. If you are lucky, you can spot *P. auriberbis* as well. ►

Penstemon virens **(front range beardtongue) along C-470 in Jefferson County, Spring 2007.**
© Mike Kintgen

◄ Further east out on the breaks and escarpments of Baca and Las Animas counties you can find *P. buckleyi.* I would love to see this species in bloom someday. I have only ever found the resting winter rosettes in winter and early spring. Late April and early May are probably best for these areas

The foothills west of the urban strip can give spectacular displays of *P. secundfilorus, P. virens, P. glaber*, *P. brandegeei* (southern), and *P. alpinus* (south to Fremont county). The hogback right behind Littleton along C-470 can be blue and lavender with *P. secundiflorus* and *P. virens* in moist years. Coyote Ridge near Fort Collins has nice displays of penstemons, along with Lory State Park. Mid- to late-May is the best time to see these penstemons.

Moving up into the mountains, two of my favorite places are Straight Creek on the west side of the Eisenhower Tunnel and Horseshoe Mountain in Park County. Visit these places in mid- to late-July depending on snow pack. Straight Creek has masses of *P. whippleanus* in multiple colors; and if you climb high enough, you can find *P. harbourii* in the screes. Horseshoe Mountain has both *P. whippleanus* and *P. harbourii* along with mass of *P. hallii*. You can see *P. secundiflorus, P. glaber*, *P. virgatus,* and *P. rydbergii* along the roadsides in South Park. These displays can be spectacular the second week of July.

Middle Park is one of my favorite places to view penstemons. Here, masses of *P. caespitosus* carpet slopes along US 40 and US 9. *Penstemon cynathophorus* can be found along both US 9 and US 40. One spot along US 40 is just inside the Kremmling city limits. *P. virgatus* and *P. glaber* can be found on slopes along county roads. Plan on catching the show in late May to mid-June depending on how early or late of a Spring we are having.

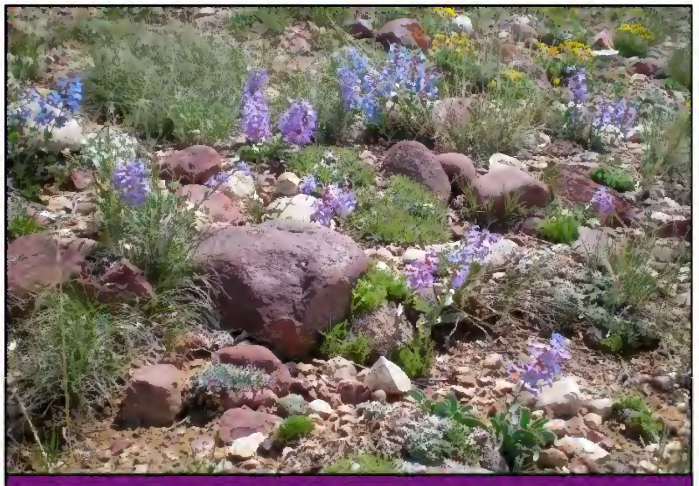
North Park is special in its own way. It has *P. cyanthophrus* scattered amongst the sagebrush. I never find more than a few individuals. *Penstemon secundiflorus* and *P. virens* appear along with more *P. virgatus*. In 2005, a recently completed oil/gas line has become a ribbon of *P. virgatus* stretching off and on for miles in a bluish-purple road across the landscape. Sadly, I never stopped to take photos and by 2006 it was largely gone. June and early July are good to view penstemon in this area, depending on snow pack.

If I had to pick one area to see the most species in one or two days, it would be Browns Park in far northwest Colorado. More than ten species have been reported. It was the site of the 2010 American Penstemon Society meeting. We saw the regional endemic *P. yampanensis, P. scarious cyanomontanus, P. fremontii, P. humilus, P. angustifolius* var *vernalis, P. pachyphyllus* var *mucronatus* and several other species.

Near the dump for the city of Grand Junction, Kenton Seth took me to see *P. moffatii.* It was beautiful on a rare rainy day in late April. Looking past the wind-blown trash there was a spectacular variety of Grand Valley native plants along with *P. moffatti*. It was a fun place to check one more of Colorado's 56 species off the list.

Penstemons are a joy in the garden and even more so in the wild. I wish you happy penstemon finding this coming season.

Mike Kintgen is curator of the alpine collections at Denver Botanic Gardens where he has worked for 14 years. He oversees all aspects of the living alpine collection, and works directly in the Rock Alpine Garden and oversees Mt. Goliath and other gardens in two of DBG's sites. Mike holds a master's degree in environmental biology from Regis University and a BS in landscape horticulture from CSU. He has worked on numerous publications covering native and steppe flora through DBG and is currently engaged in helping to rework the North American Botanic Garden Strategy for Alpine Plant Conservation.



Penstemon pachyphyllus **(thickleaf beardtongue) at Lookout Mountain, Moffit County.**
© Mike Kintgen

Featured Story

How Native is Native Enough? The Argument between Natives and Nativars

By Ann Grant

So you've decided you want a native garden. You've heard that native plants help pollinators and the insectivorous birds that feed on them. You know that native plants can provide berries and seeds for birds and provide cover for wintering birds. You like the look of a more natural garden, and want to use less water, fertilizer, and pesticides. You are bored with mowing and caring for the bluegrass lawn, and struggling to keep it green during our increasingly hot and dry summers. You like the look of a colorful garden in the growing season, but are tired of replacing annuals every year. You think it's good for the planet. You're thinking if you wanted an English country garden, you'd live there.

The Argument for Natives

It is widely accepted that our native pollinators are more attracted to our native plants. The reason is that the plants have co-evolved with the insects which have specialized mouthparts for accessing nectar or prefer to feed on certain plants.

Adult moths and butterflies lay their eggs on plants and their larvae eat the host plants. The monarch butterfly, the poster child for our native butterflies and pollinators, lays its eggs exclusively on milkweeds (*Asclepias spp.*). Another well-known example is the yucca moth, which has a symbiotic relationship with the yucca plant. The yucca plant depends on the moth solely for pollination, and the moth lays its eggs in the flower where the emerging larvae eat some of the seeds.

A recent article in Smithsonian online (Smithsonian 2018) brought attention to a scholarly article on backyard birds and native plants. Suburban yards with less than 70% native plants could not sustain nesting Carolina chickadees. There simply weren't enough insects laying their eggs and caterpillars feeding on the non-native trees and shrubs for the chickadee parents to forage on. Tree canopies can provide most of the biomass to make up that 70%.

Natives and Nativars Defined

The most desirable plant for a native plant garden is a native plant. A native plant is generally defined as one which has existed in the local ecosystem before the advent of settlers from other continents. A native plant has coevolved with native insects, pollinators, birds, and other animals.

At a local garden center, you may encounter cultivars, named varieties, hybrids, and patented plants. All these plants have been selected, propagated, and manipulated in some way so that they are different from the original native plant. Some may be descended from plants from other continents. Some may be so changed, hybridized, and back-crossed that they have lost the ability to reproduce themselves.

Plants which are similar to or derived from native plants are referred to as nativars, or cultivars of native plants. They are often touted as being as good as the native and may be closest to a native you can get. The reasons for this are complex. Selecting and naming a plant, or creating a plant which is so different and unique that it can be patented, gives the plant grower a marketing edge. The plant may be bigger, more floriferous, a unique color, more hardy, or disease resistant, compared to the parent plants. None of these traits have anything to do with production of nectar and pollen, how attractive the blooms are to pollinators and birds, or the palatability of the foliage to hungry caterpillars.

***Physocarpus monogynus*, mountain ninebark.**
© Kelly Ambler

How Do We Know if a Nativar is as Good as a Native for Attracting Pollinators and Birds?

Most of the time we don't know. What we do know is that cultivars with red leaves are less attractive to insects. It is thought that the red colors, which are frequently due to anthocyanin pigments (think blueberries and raspberries), may be giving clues that other untasty and possibly poisonous substances may be present in the plants (Blaisden and Tallamy 2018). Insects don't lay their eggs on these leaves, and their larvae do not feed on them. Some red-leaved cultivars may not even be the same species as our natives. *Physocarpus opulifolius*, (eastern or common ninebark) is available with leaves in various shades of red and gold. It has been offered by local nursery personnel as a "native." Our native species is *Physocarpus monogynus*, mountain ninebark.

Green and white variegated leaves, and yellow or chartreuse coloration do not seem to repel insects the same as their red counterparts. Perhaps this is because the insects perceive the variegation as if the plant were in dappled sunlight, or as young leaves, which are preferentially eaten.

Extremely doubled flowers like roses and peonies have been bred for decades, perhaps centuries, to give their glorious blooms. The extreme doubleness makes it very difficult for pollinators to get at the nectar and pollen in the flower heads. Indeed, the breeding process has in many instances produced defective flowers which may be missing anthers or have incomplete ovaries that cannot produce seed at all. These complex hybrids must be cloned by cuttings, grafting, or tissue culture to produce the variety from the mother or stock plant (Reynolds and Tampion 1983).

The popular *Echinacea purpurea* (purple coneflower) is widely available in garden centers and big-box stores across the nation. It is not a native of Colorado, but rather of the midwest. Our native is *Echinacea angustifolia,* the narrow-leaved coneflower, or black samson. The yellow *Echinacea paradoxa* used for hybridizing is also not a Colorado native.

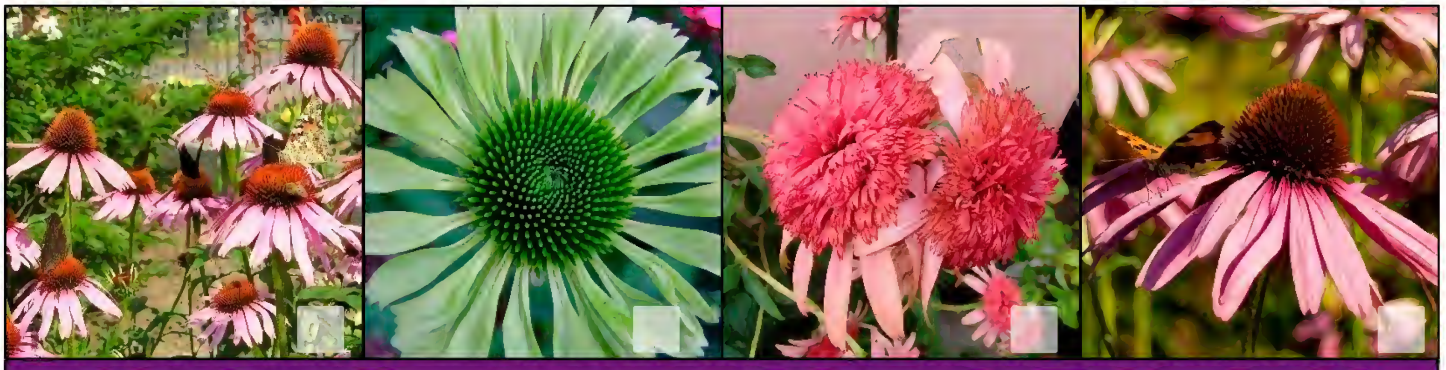
Let the Buyer Beware

This old adage is especially true when it comes to buying natives. A well-respected online and catalog retailer offers new and exciting plants for western gardens. In preparation for this article, I searched its offerings for penstemons. Gorgeous pictures of our native plants leapt out at me, many of the stills apparently buzzing with bumblebees actively seeking nectar and pollen. What more could you want? The names of the plants reveal the truth. *Penstemon barbatus* 'Rubycunda' is a red cultivar derived from the straight species. It is advertised as being attractive to bees and butterflies. Beautiful? Yes. Native? No. We do not know how a nativar may stack up against the genuine native in being beneficial to pollinators and their caterpillars without research. This quality plant vendor offers many straight species, which are the ones I would go for.

What Research has been Done on Cultivars of Native Plants?

Enter Dr. Annie White. Her dissertation "*From Nursery to Nature: Evaluating Native Herbaceous Flowering Plants Versus Native Cultivars for Pollinator Habitat Restoration*" is the most extensive published research directly comparing native plants and closely related nativars (White 2016). There is also an online article (https://pollinatorgardens.org/2013/02/08/my-research/). Many online articles also reference her work.

White monitored bees, butterflies, moths, wasps, flies, and beetles on randomized plots of natives and cultivars. Seven pollinator groups of insects were ►



Purple coneflower (Echinacea purpurea) has been bred into more than 100 cultivars. From left to right: the straight species (© Maja Dumat), 'Green Jewel' (© Sylvia Mayer), 'Pink Double Delight (© Gianna Elena) which has inaccessible nectaries, and 'magnus' (© Peter Rosbjerg) which is more densely flowered but otherwise little changed from the straight species. Photos from Flickr Creative Commons.

Native Parent	Cultivar	Parent Native to Colorado?	Pollinators Preference
Achillea millefolium	*A. millefolium* 'Strawberry Seduction'	yes	Native preferred
Agastache foeniculum	*Agastache* 'Golden Jubilee'	no	No preference
Asclepias tuberosa	*A. tuberosa* 'Hello Yellow'	yes	No preference
Baptisia australis	*B. x varicolor* 'Twilite'	yes	Native preferred
Helenium autumnale	*Helenium* 'Moerheim Beauty'	no	Native preferred
Monarda fistulosa	*M. fistulosa* 'Claire Grace'	yes	No preference
Penstemon digitalis	*P. digitalis* 'Husker Red'	no	No preference
Rudbeckia fulgida var. fulgida	*R. fulgida var. sullivantii* 'Goldsturm'	no	No preference
Symphyotrichum novae-angliae	*S. novae-angliae* 'Alma Pötschke'	may be garden escapee	Native preferred
Tradescantia ohiensis	*Tradescantia* Red Grape'	no	Native preferred
Veronicastrum virginicum	*V. virginicum* 'Lavendelturm'	no	Cultivar preferred

Paired natives and cultivars used in Dr. Annie White's study (see reference list).

◄ identified. Native plants were chosen as native to the study plot in Vermont or nearby counties.

Her data demonstrates that insect pollinators prefer to forage on native species (five cases), or have no preference (five cases), with one exception. For one native, *Veronicastrum virginicum* and its cultivar 'Lavendelturm,' the cultivar received more pollinator visits. In general, her data suggest that the less manipulated the cultivar is, the more likely it is to be as attractive to pollinators as the native. Presumably the less extensive genetic change has preserved the flower structure and pollen and nectar resources of the original native. The factors of flower morphology, and nectar and pollen abundance, flower color, floral abundance, and length of bloom all may affect pollinator preferences.

Of the five pairs where the native is preferred over the cultivar, all have been hybridized, or are suspected to be, except one. (Early plant hybridizers were not very open about their crosses, and in some cases, plants were chance discoveries in gardens.) *Achillea millefolium* 'Strawberry Seduction' was selected from a plant breeding program, but was not hybridized. Red flowers are known to be less attractive to bees, the primary pollinator in this study.

White also studied an *Echinacea* and three cultivars:

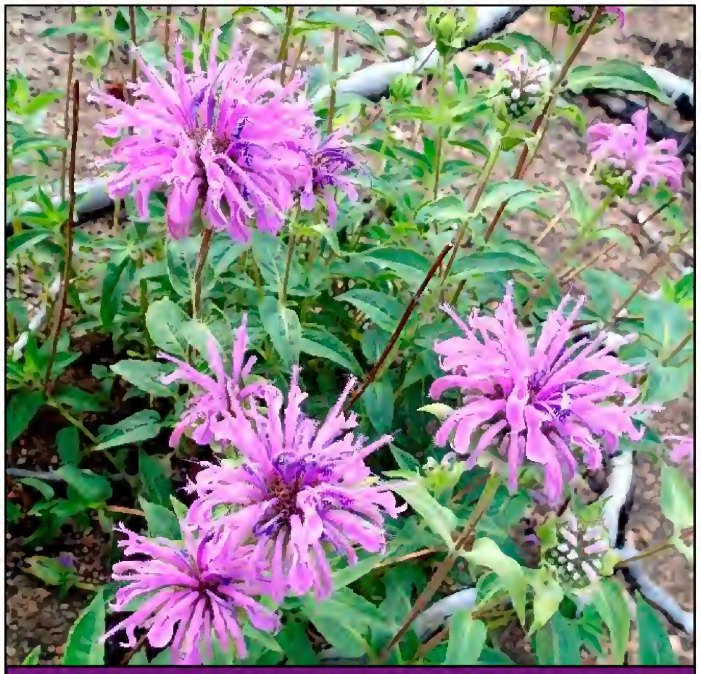
- Open-pollinated, USA native *Echinacea purpurea*;
- Seed cultivar, open-pollinated, selected for color/form (*E. purpurea* 'White Swan');
- Double-flowered cultivar (*E. purpurea* 'Pink Double Ddelight,' patented); and
- Interspecific hybrid cultivar (*Echinacea* 'Sunrise,' patented).

All bee pollinators preferred the straight species over the three cultivars. Butterflies and moths preferred the native over the two patented varieties, but there was no difference in these pollinator counts for 'White Swan.' Non-bee species (flies and beetles) showed no preference in choice of native or cultivar. White posits that bees, which are obligate on floral resources, may prefer the native as the pollen and nectar sources are richer or more available. Other insects may be less dependent on the floral resources and find the cultivars equally satisfactory

Research at Mt. Cuba Center in Delaware

Research on beebalm *Monarda* species and cultivars at Mt. Cuba was conducted over three years and centered on the species' suitability for Mid-Atlantic gardens, particularly resistance to powdery mildew (Coombs 2016). In 2016, observations of visits by hummingbirds and butterflies/moths were added to the study. Of the 40 *Monardas* studied, six were native species. Four plants of each taxon were grown, so that the 24 native plants were competing with a sea of 136 cultivar selections and hybrids. Nevertheless, pollinators were able to find their way to the natives, and one, *Monarda didyma (*which is not a Colorado native), ranked in the top five for attracting hummingbirds.

Monarda fistulosa 'Claire Grace' ranked number one in attracting bees, probably in response to superior nectar resources. 'Claire Grace' was discovered as a naturally occurring variety, and so its parentage is not exactly known, but presumably it has not been manipulated to a great extent. Pollinator results for the Colorado native *Monarda fistulosa* were not cited, but it was rated of near the bottom as a garden plant, probably due to its susceptibility to mildew. We can assume that *Monarda fistulosa* in this study was less attractive to pollinators as it was not ranked in the ►



Wild bergamot or beebalm (*Mondarda fistulosa L.* var. *menthifolia*) is common along roadsides and in meadows between 3500-8500'. © Marlene Borneman

◄ top five. This is in contrast to the study by Annie White, which studied all pollinators, including bees, and ranked the native and cultivar equally. This difference in results could be due to poor performance overall of mildewed plants at the Mt. Cuba Center, or to the inclusion of bees in the study by Dr. White.

What is in the future?

Most of the research on cultivars at Mt. Cuba has concentrated on varieties and cultivars for use in mid-Atlantic gardens, with no attention given to pollinators. With the increased awareness of the importance of pollinators, and the involvement of Dr. Doug Tallamy, hopefully more research on natives and their cultivars and their suitability as nectar sources for pollinators and forage for larvae will be forthcoming. Research results on individual plants from other parts of the country should be interpreted with caution, as our native plants are not well adapted to regions with high rainfall and high humidity.

In some cases, very limited to be sure, some nativars offer enhanced nectar resources to pollinators. This could be valuable in providing concentrated sources of food for foraging bees and adult butterflies and moths. If plant breeders can produce plants which are more appealing to gardeners with greater hardiness, more uniform plant habit, exciting colors and longer periods of bloom, why not also create flowers which would be enhanced nectar sources? But without research on specific natives and their cultivars, we don't really know.

Where Can I Buy Native Plants?

A list of suggested local and online retailers appears on the CoNPS website (https://conps.org/gardening-with-native-plants/). The Colorado Native Plant Society has an online plant sale in the spring and fall. When you visit your local nursery, ask to speak to the person in charge of ordering natives. Only by making ourselves known can we help create demand so that our local garden centers will begin stocking more natives.

Citizen Science Projects on Natives, Nativars, and Pollinators

Project BudBurst, an online, web-based plant phenology project hosted by the Chicago Botanic Garden, is conducting a nationwide Nativar Research Project. For more information, visit https://budburst.org/projects/nativars. Denver Botanic Gardens is a partner and provides lists of plants involved in the study and information on how to get started (http://www.botanicgardens.org/science-research/phenology/budburst-gardens). Unfortunately, there is no easy way to get the plants—you have to go searching on your own. But why not start something in your neighborhood, local park, or natural area?

Nature's Notebook, a project of the National Phenology Network, has multiple citizen science projects to choose from involving natives https://www.usanpn.org/nn/campaigns. Nectar Connectors focuses on collecting data on native plants and pollinators. You are limited to the plants in their database, but a good number of Colorado natives are included.

Your city, town, or county may also have citizen science projects to get involved with.

Ann Grant, PhD, is the CoNPS horticulture committee chair. She and her husband opened and operated a wholesale (East Vine Farms) for 12 years. She has a passion for growing and propagating natives. The horticulture committee is working on a project for monitoring native plants in gardens. The program is called Project BudBurst. If you live in Colorado, garden with native plants, or volunteer at a garden, park, or other natural area and would like to participate in this citizen science project, please email conpsoffice@aol.com to sign up.

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Ault, J. 2003. "Breeding and development of new ornamental plants from North American native taxa." *Acta Hortic.* 624:37-42.

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"Native Enough…" *continued on page 32* ►

Lexicon of Plant Terms

By Ann Grant

Below is a list of terms relevant to Dr. Grant's article, "How Native is Native Enough?"

Clone: An organism that is genetically identical to its parent. Plant clones are often generated through cuttings

Cultivar (Cultivated variety): A plant which has been selected for a particular trait and propagated clonally. It has very narrow genetics and the plants are very uniform. Most of named ornamental perennials plants are cultivars, such as *Salvia* 'May Night.'

Designated PP or PPAF (Plant Patent Applied For): Illegal to propagate without permission. Seed may not come true to type, and it is also illegal to collect and sow seed.

Ecotype: A native plant which has been grown in a specific ecoregion. Differences among ecotypes may be quite slight, not warranting subspecies, nor varietal designation.

Genetically Modified: Plants are genetically modified in the laboratory using highly sophisticated techniques to manipulate genes. This is an expensive process and the payback from native plants is usually not commercially feasible.

Hybrid: A plant which has been bred through interspecific crossing, or more rarely, intergenetic crossing from established pure seed strains. Resulting hybrids are frequently propagated clonally. F1 hybrids are the first generation of crossing and frequently refer to seed.

Nativars: A trendy term applied to cultivars of native plants, which may also be patented and trademarked.

Native plant: A plant which co-evolved with pollinators, birds and other wildlife in an ecoregion before the advent of settlers. A plant occurring naturally, without the intervention of humans.

Open Pollinated: Plants are allowed to cross-pollinate in open fields by native or supplied pollinators.

Patented Plants: A plant that the US Patent Office has determined is sufficiently different from similar plants to constitute a new and novel invention. Almost always cultivars or hybrids.

Pure seed strain: A seed strain which has been selectively bred for generations to yield a desirable or marketable trait. *Echinacea* 'White Swan,' a white sport of *Echinacea purpurea*, is an example. Many commercial seed varieties are pure seed strains.

Straight Species: Another term for wild-type.

Trademark: A name applied to a plant grown by an organization that uniquely identifies the plant or organization. The plant may or may not be manipulated in some way (hybrid or cultivar). A marketing strategy.

Variety: A variation of a plant which occurs in nature, frequently a color variation, but may refer to other growth characteristics. An example is *Campanula rotundiifolia* var. *alba*. Seed will come mostly true to type if it is a pure seed strain. Sometimes incorrectly designated as the cultivar *C. rotundifolia* 'Alba,' a practice unfortunately quite common in the horticultural industry.

Wild-pollinated, Wild-collected Seed: Seed collected from native plants growing naturally in the wild. Usually done to collect seed for restoration projects. Allowed with land-owner permission.

Wild-collected Plants: Frequently done illegally, although it is sometimes allowed with landowner granted permission. Plants wild-collected frequently die once transplanted.

Wild-type: A plant that has not been modified by selective breeding or hybridized, and can be found in its native habitat.

Spotting a cultivar: As with the cultivar plant tags in the image above, they usually have plain language names associated with them that describe what is special about a particular cultivar. The breeders who create cultivars usually name them to keep track of varieties and help with marketing the plant. © Habitat Network http://content.yardmap.org/learn/nativars-native-cultivars/

Conservation Corner

A Tale of Two Wildflowers

By Suzanne Dingwell

One is rare and endemic to Colorado; the other is common throughout the lower 48 states, Greenland, and the Canadian Territories. One is pollinated mainly by native bees, one mainly by wind. One forms a low-growing mat with flowers of graceful beauty, one is slender and upright with flowers barely discernible. This is a tale of two very different native wildflowers and their unique properties and adaptations. A tale of their contributions to their ecosystems, and to us. A tale that raises questions about their future and our own choices in forming that future.

The Rare and Endemic Penstemon

First the rare one, *Penstemon debilis* (Parachute penstemon). Not only is this wildflower rare and endemic, but it is native to only Garfield County in Colorado. Parachute penstemon has adapted to life on the oil shale of the white talus of the Green River formation. It thrives on steep, unstable, south-facing slopes, shifting with the sands of time. As shale on the slope slips inevitably downward, the penstemon gradually becomes buried. But if the plant's roots are firmly enough established, buried stems will creep downward, too, transforming into functional rhizomes and giving rise eventually to new leaves and flowers, contributing to the stability of the slope. Funnel-shaped flowers range from pale lavender to white, blooming in June and July.

***Penstemon debilis* (Parachute penstemon).**
© 2018 Jill Handwerk, team leader for the botany and vegetative ecology team, Colorado Natural Heritage Program.

According to Dr. Andrea Wolfe, a professor at Ohio State University who has made a specialty of studying plant systematics and evolution, Parachute penstemon is "… one of the rarest plants in North America, no matter what measure is used to gauge its status: geographic distribution, edaphic substrate, number and size of populations, genetic diversity, or population structure."

Edaphic: An abiotic, or non-living, factor relating to the physical or chemical composition of the soil found in a particular area.

Making its stand on these dramatic slopes which are also replete with a number of toxicity challenges including salts, selenium, boron, and other unusual elements, Parachute penstemon is pollinated by a variety of native bees, primarily *Osmia brevis*, and a masarid wasp. *O. brevis* is responsible for pollinating two other rare penstemon species in Colorado: *P. harringtonii* and *P. penlandii*. This mutualistic relationship between native bee species and penstemons is yet another building block in the web of life, each block dependent on, and giving support to, other blocks.

Supremely adapted to this difficult site and overcoming heat, drought, toxicity, and gravity, Parachute penstemon is listed as G1S1, meaning it is threatened to the highest degree, both globally (G1) and within the state (S1).

Unfortunately, it resides within the Mahogany Zone, a rich repository of oil shale. Ironically, the Mahogany Zone owes both its name and its richness to plants. The name for its color: a red-brown imparted to rock high in kerogen content. And of course, the richness is due to the high percentage of plants once concentrated in the Piceance Basin. Although threatened by all the usual suspects such as recreation, grazing, and habitat fragmentation and loss, the most clear and present danger to the existence of Parachute penstemon is mining, already active in the area.

In a detailed analysis of various methods that could be used to mine in the area, United States Geologic Survey acknowledges that environmental impacts include extensive land disturbance, disposal of large quantities of spent shale, potential leaching of organic and inorganic pollutants, high water usage, and degraded air quality. Although Parachute penstemon received some element of protection by being listed as "Threatened" by United States Fish and Wildlife Service in 2011, benefits are limited in that most of the plant's populations exist on private land owned by energy development companies and not on federal land where the distinction would be useful. Some ►

A slope located in the Mahogany Zone.
© Jill Handwerk

◄ populations of Parachute penstemons have been extirpated, but in a report for this article, Jill Handwerk indicated that her survey in fall of 2018 showed populations of *P. debilis* on private sites appear stable for now.

The Common Field Sagewort

In direct contrast, *Artemisia campestris* L. var. *caudata*, or field sagewort, is native not only to Colorado but also to vast areas of the US and beyond. It has adapted to a wide variety of habitat types and altitudes, from coastal to alpine, woodland to prairie. It is often a pioneer species, first in after fires, destruction by vehicle, or other disturbance. Pioneer species can be important in holding the ground until other native species get a foothold. Its deep taproots help prevent erosion. Its wide distribution is probably the reason field sagewort goes by so many common names including field sagewort, beach wormwood, and field mugwort being just a few.

This hardy forb produces an abundance of tiny blooms on narrow panicles of crowded composite flowers. Some small bees and flies seek pollen from its flower heads, but it is primarily wind pollinated. However, both leaves and flower heads of field sagewort feed many insects, including several grasshopper species and the caterpillars of numerous butterflies and moths. It is also a source of nesting material for native bees. Sharptail grouse, rabbits, and other small mammals feed on the seeds and fruits. Although field sagewort is considered stable in our state, loss of habitat is an ongoing threat.

Despite its ubiquitous presence, or perhaps because of it, field sagewort has not been the subject of much research. Last year when Boulder County Parks and Open Space tried an experimental treatment in a field being overtaken by cheat grass, they decided to hedge bets against any unforeseen damage to field sagewort populations by collecting seed. Because germination rates can be low and unpredictable for unknown reasons, a large quantity was gathered. Fifty pounds of seed heads, gathered by volunteers, are now in the process of being cleaned and will be banked in a temperature-controlled vault, perhaps providing a basis for expanded knowledge of practices that increase germination rates for restoration purposes.

Both Wildflowers are Worts

A characteristic shared by both these wildflowers is the inclusion of “wort” in their common names. Parachute penstemon was once a member of the figwort (Scrophulariaceae) family. During the Middle Ages herbalists and other healers were often guided by what came to be known as the Doctrine of Signatures, based on the premise that if a plant part resembled a human body part, it could be used to treat problems or diseases that occurred there. The word wort, from Old English “wyrt” (meaning plant) was applied to any plant used to treat ailments. All parts of various plants in the figwort family were used in a number of medicinal applications. One popular treatment was topical relief for skin conditions. In North America, native peoples used all parts of the field sagewort. The seeds were eaten as grain and different parts of the plant provided treatment for an amazing array of troublesome health conditions. The pulverized roots had some particularly interesting qualities. They could be applied as a perfume or, should the need arise, be placed on the face of a sleeping man in order to steal his horses.

So here is the tale of two wildflowers, each inhabiting a unique place in the complex set of relationships that form our natural world. Because of their particular adaptations, each may have possible contributions yet unknown to us. A critical part of conservation efforts, both in the field and at home, is recognizing that the value of plants goes far beyond their humanly perceived beauty. As loss of habitat and climate change take their toll on the landscape, it’s up to each of us to use our knowledge as a tool to teach others, and to actively advocate for conservation.

Sue Dingwell started her native plant journey in Florida, where the revelation of what plants could do in the hot sand scrub was a transformative learning experience. She became a member of the Florida Native Plant Society and used her background in education to become a dedicated advocate of native plants and conservation. A Master Naturalist in both Florida and Virginia, Sue is currently a member of both the Virginia and Colorado Native Plant Societies. She lives in Boulder.

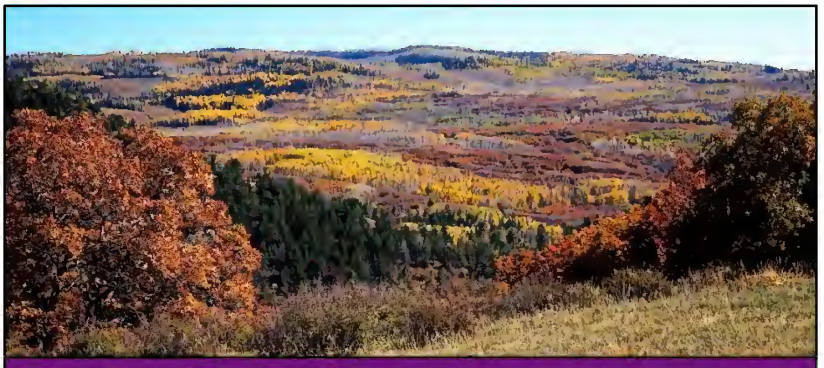
“Two Wildflowers…” References *continued on page 33* ►

Gambel Oak's Last Stand

By Jim Borland

Over the western slope of Colorado, Gambel oak (*Quercus gambelii*) is found almost everywhere from the southern border north to Wyoming. On the eastern slope the situation is a bit different. Along the foothill-prairie cline, this oak's northern reach can be found somewhere within the confines of the community of Genesee on the greater mass of Genesee Mountain. North of I-70 this oak can be found only sporadically, and then only as individuals or small groups of single stems. Most accounts of this oak in Boulder County and north attribute its existence to the planting hand of man.

Apparently, Genesee Mountain provides the last massive heap of protective soil and stone that affords enough of a haven to prevent consistent flower-killing low spring temperatures and allows for a growing season long enough to keep the parent plants alive and forming next year's flower buds. Here it is found growing strictly on southeast facing slopes—the warmest slopes. Contrary to popular belief, southeast slopes in the Front Range foothills are actually warmer than south or west facing slopes due to almost daily cloud formation around noon that subdues sunlit warmth on west and southern exposures.



***Quercus gambelii* (Gambel Oak) shows its colors in Fall.**
© Al Schneider, http://www.swcoloradowildflowers.com/

Discovered by an ornithologist William Gambel, working for the ornithologist Thomas Nuttall, Gambel oak was only one of numerous oak species thought to exist in Colorado before the turn of the century. Since then, botanists have realized that the multitude of leaf shapes and forms described (sometimes on the same plant) and numerous plant forms (heights and widths) all belong to a single, highly variable species. Thus, the field of botany became just a bit easier for all.

Gambel oak is a member of the white oak group with round leaf lobes and wood superior for aging Kentucky liquid sunshine and moonshine since it does not allow solutions to seep through, unlike wood from the red oak group which is superior for absorbing solutions like stains due to its open pores. White oaks are also separated from the reds by their ability to mature acorns in only one year instead of two.

Highly resistant to disease and insects, Gambel oak is not resistant to fire. As a result, this highly flammable species has developed a rather unique response to the otherwise destructive nature of fire through the formation of both underground stems or rhizomes and lignotubers. Dormant buds on rhizomes are released from their dormancy when aboveground stems are destroyed or stressed, thus destroying or diminishing the dormancy-inducing effects of hormones produced in the leaves. Upon release, new stems arise in profusion much as they do with aspens, thus renewing in place the original colony. Dormant buds on lignotubers—swollen regions of the trunk near or just below the ground—act likewise upon release, producing a plethora of new stems. Hot fires that destroy all living matter within the top layers of soil destroy rhizomes and lignotubers alike, thus forcing recruitment to come from some neighboring, still-living colonies.

Aside from its rather volatile standing firewood nature, Gambel oak provides much needed fodder and nut crops or mast for wildlife. Mule deer, elk, turkey, jays, bears, and squirrels, among other smaller beasts, revel in the annual crops of acorns and browse on them throughout the year.

Gambel oak gets old too, just like mountain mahogany, aspen, ponderosa pine, and other woody foothill plants. Renewal, as it is for these other plants, is accomplished in nature by fire that provides open soils and sunny sites. Without this natural renewing force, Gambel oak is ultimately destined to lose its foothold on this northernmost locale.

Jim has been fooling around with native plants for more than 40 years in private, commercial and public venues. His home garden contains thousands of native plants, most grown from seed at home and now not supplementally watered for 20 years. Jim has written hundreds of articles, given talks too numerous to count, and continues to grow and plant the two or three native plants not yet in his garden.

Cliff Fendlerbush, *Fendlera rupicola*

By Judy Kennedy

The Cliff fendlerbush (*Fendlera rupicola*) is, in my opinion, one of the most beautiful flowering shrubs of the Western Slope. Depending on conditions, western mesas can appear to be dusted with snow from late April to early June because of the showy white blossoms on the fendlerbush. I have found it in many locations in the Colorado National Monument outside of Grand Junction.

Those bright white flowers are fragrant, spoon-shaped, two inches wide, and faintly edged with pink. The petals are narrow at the base and widen abruptly making the flower shape very distinctive. The pink buds are single or in small clusters.

It can be found at elevations from 4,000-8,300' in Nevada, Utah, Colorado, Arizona, New Mexico, and Texas. Fendlerbush thrives on dry rocky slopes of igneous or limestone soils where it can endure intense heat and considerable drought. Its deep roots grasp the soils and hold the plant in place where it often grows in association with juniper, pinyon pine, and mountain mahogany. It is generally slow-growing.

Fendlerbush is a member of the Hydrangeaceae family and a relative of cultivated hydrangeas. It also goes by the common name Mock Orange and can grow to six feet.

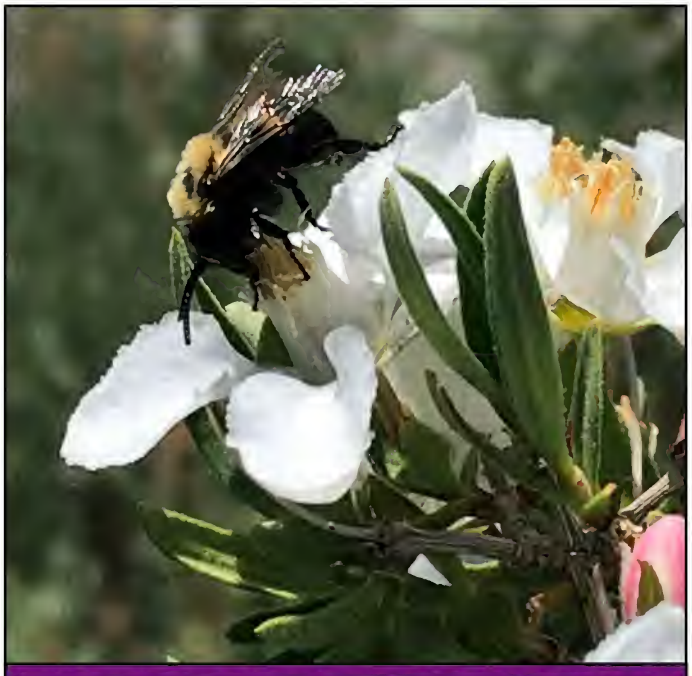
Its new bark is a reddish-tan, which becomes gray and shredded with age. The leaves are shiny and elongated, dark green above, and dull green on the underside. They are thick, attached oppositely, and have three prominent sunken veins. The fruit is a four-celled, gray-green capsule that looks "acorn-like" and remains on the plant all year. Fendlerbush generally reproduces from the seeds that the capsule holds, although it can be "cloned" via branch cuttings.

George Englemann and Asa Gray named this species after Augustus Fendler (1813-1883) who was a respected 19th century collector of plants. Fendler collected for a few seasons in the southwest. *Rupicola* is Latin for rock dweller.

The Navajo people used a decoction of the bark to kill head lice and as a cathartic. The Hopi also used it in various religious ceremonies.

Fendlerbush provides excellent browse for big horn sheep and deer. It has been, and still is, a valuable resource and a truly beautiful addition to the red rocks and canyons of Colorado.

Judy Kennedy is a Colorado Native Plant Master® who lives in Glade Park, CO. Glade Park is right above the Colorado National Monument where she and her husband, Dave, do most of their hiking. She is also a Master Gardener in both Colorado (CSU Extension) and Arizona (University of Arizona).



Cliff fendlerbush (*Fendlera rupicola*) is visited by a bumblebee (*Bombus sp.*). © Mary Menz

Distinctive petal shape of Cliff fendlerbush (*Fendlera rupicola*). © Mary Menz

Report from the High Altitude Revegetation Conference by the Society for Ecological Restoration

By Sue Dingwell

Rocky Mountain Chapter Conference

Not even the March bomb cyclone, exploding right into the middle of it, could thwart the success of the 2019 High Altitude Revegetation conference for the Society for Ecological Restoration.

With the second day cancelled, some fast footwork by the planners set the stage for concurrent sessions to run on the final day, while still allowing the entire audience to hear both remaining keynote speakers. The conference featured reports of successful restorations, new research, creative thinking, and motivational encouragement.

The first keynote speaker, Kingsley Dixon, a restoration expert hailing from Australia with 40 years of experience, gave a talk focused on the need for effective seed-based solutions, a talk peppered equally with suggestions for strategies and calls for immediate action. He said that lots of people who don't usually have anything to do with restoration are now becoming involved with restoration projects. While the restoration culture previously was confined to a smaller group of interested parties, it now includes green businesses and climate change activists. Urban landscape and architecture, horticulture, clinical medicine, and public health are all among the many new categories of interested parties.

"Bring the science to the people," said Dr. Dixon. He stressed that integrating disciplines will be a key to success while engaging First Peoples and traditional owners of the land to unlock bottlenecks. It is important to innovate, accept local solutions, and think fast track to make influential change. Talk as champions to champions in the community, he advised.

According to Dr. Dixon's estimate, 2.1 million tons of seed is needed just for the life of the Bonn Challenge alone, (http://www.bonnchallenge.org/content/challenge), the biggest restoration project currently underway worldwide. Being smart with seed is the start of the journey for scale and diversity, he said, with an emphatic demand for ethical sourcing.

Current seed-to-establishment ratios overall are woefully low, he noted, and then listed some of the following tools for boosting success rates: seed pelleting; inoculating with slurry and coating seed before sowing; harnessing the soil's microbiome; and creating synthetic topsoil.

During the brief question period, a member of the audience volunteered that providing irrigation after germination often results in plants that are not drought tolerant. Dr. Dixon agreed, and then promised that later this year he will be publishing a new paper *International Standards for Native Seeds in Restoration,* which will include information on a treatment he is using in Australia—a new compound of root treatment that instructs the plant to live dry.

His repeated photos of the massive amounts of land now being restored after cessation of mining operations gave special awareness to the importance of work on these sites.

Several other talks addressed both ongoing efforts and new research focused on this unique restoration. There were reports on work at the Alberta Oil Sands region, the Minnie Lynch Mine in Saguache, CO, several abandoned mines in Colorado's White River Forest, and the Jonah Field in the Wyoming Powder River Basin. Each of these places of course had their own site-particular challenges.

Other highlights of the conference:

- Reports of excellent success at the Canadian Oil Sands site using *Carex aquatilis*, (also native in CO), and *Juncus balticus* as dominant native species in what had been peat-accumulating wetlands. There was no definition to the mandate for land to be reclaimed to equivalent land capacity, so the speaker used sustainable biomass production equivalent as a guideline. This will not take the land back to what it was, but it was attainable and native. The Carex was able to out-compete the invasive *Typha latifolia* (cattail), in all but continuously standing water.
- Clever re-engineering and replicating planting of natives already in situ at the Minnie Mines site resulted in a highly successful and beautiful restoration of this badly degraded site. A public- ►

Nikanotee Fen Restoration. © Canada's Oil Sands Innovation Alliance

◄ private collaboration helped with financing and when land ownership problems arose, goals were handily met by taking the extra step of doing a formal re-survey of the land.

- In the White River Forest sites, Butterfly Burrell achieved between 53-65 percent survival of native forb transplants, and adding woody species is next. At the Hope Mine, they had problems with outbreaks of exotic invasives brought in with compost from a landfill center.
- Photos of the Jonah Field, with wells re-plugged in 2013, showed a pleasing green cover, but investigation of seedling restoration outcomes showed variable results. Cover on the planted well heads had more diversity than the unplanted well heads, but also a higher cover of introduced species. The woody species had very low persistence.

Fires and forest management issues were subjects of several talks, two issues further complicated by the effects known and unknown of climate change. Speakers agreed on the fact that restoration efforts must be informed by, but not constrained by, the historical range of variability. As our climate becomes warmer and drier, it was noted, we need species adapted to survive in those conditions. Going back far enough in the evolutionary history of an area may provide clues about native species that were once present in a forest, even if they are not currently there. More open forests are critical to multiple goals including forest health; the survival of plant and animal species, including rare ones in both categories, and public safety.

A fascinating account of ongoing work at the famous Tuolumne Meadows in Yosemite, with *Carex scopulorium*, as the dominant native, followed a talk about wetlands restoration and hydrologic regimes. Read more here: https://parkplanning.nps.gov/projectHome.cfm?projectID=64489.

Ideas in the talk given by the final keynote speaker for the event, Dr. Don Falk, another stellar expert in the (https://snre.arizona.edu/people/donald-falk)

restoration field, make a fitting conclusion for this conference summary as well. Dr. Falk proposes that a new vision is needed for restoration. Ecosystems will reorganize, he said, and many species will not be able to keep up with changes occurring at the current velocity rate as the combined effects of widespread fire and climate change make themselves felt. We must refocus our efforts on finding long term solutions. Falk said we must:

- Promote resistance and persistence;
- Increase recovery capacity;
- Understand how communities re-organize after disturbance; and
- Keep nature as our primary teacher.

Sue Dingwell started her native plant journey in Florida, where the revelation of what plants could do in the hot sand scrub was a transformative learning experience. She became a member of the Florida Native Plant Society and used her background in education to become a dedicated advocate of native plants and conservation. A Master Naturalist in both Florida and Virginia, Sue is currently a member of both the Virginia and Colorado Native Plant Societies. She lives in Boulder.

Recent and Relative Reading

Simons, Paul. "Plantwatch: is sphagnum the most underrated plant on Earth?" The Guardian. 15 January 2019.

https://www.theguardian.com/science/2019/jan/15/plantwatch-is-sphagnum-the-most-underrated-plant-on-earth

"The Digitization Conveyor Project Hits 2 Million Scans." Smithsonian National Museum of Natural History, The Plant Press, 7 March 2019.

https://nmnh.typepad.com/the_plant_press/2019/03/the-digitization-conveyor-project-hits-2-million-scans.html

Yong, Ed. "Plants Can Hear Animals Using Their Flowers: And they react to the buzzing of pollinators by sweetening their nectar." The Atlantic. 10 January 2019.

https://www.theatlantic.com/science/archive/2019/01/plants-use-flowers-hear-buzz-animals/579964/

Research and Reports

Climate Change on the Rocks—Investigating the Potential Effects of a Changing Climate on a Cliff Habitat Specialist, *Aliciella penstemonoides*

By Richie Hum

CoNPS annually funds grants to support field and laboratory research as part of its John W. Marr and Myrna P. Steinkamp grant programs. Richie Hum was awarded a Steinkamp grant of $1000 in 2017 to help fund his study of Aliciella penstemonoides. *Reporting on projects is a requirement of all grant recipients. In this issue, we are pleased to feature Hum's report.* MM

More than two thousand vertical feet separate my summer-tattered shoes from the torrents of the Gunnison River. The depth of the chasm is incomprehensible and displaces vertigo with stupefaction. Yet the inordinate pull of gravity cultivates a heighted sense of awareness; the mid-summer sun beams upon the south facing wall of the Black Canyon causing a stifling heat, the swift current below drowns out all other sounds, the auto-locking rappel device feels a bit more sensitive than usual, and the 10.5-mm nylon rope looks a bit thinner than it should.

As I sit in a harness near the end of the free-hanging rope, a welcome breeze regrettably spins me around until I am forced to face the empty space of the chasm below. A pegmatite dragon of unexplainable proportions becomes forever painted into my memory (Figure 1). But with the breeze comes an upward draft and the strong scent of a phlox flower with a distinct dialect. I thrash my legs about in an effort to turn myself back toward the cliff and discover a few lonely royal purple flowers, no larger than a Monopoly game thimble, amidst a bouquet of withered perennial stalks anchored into a deep crevice by a small basal rosette of oddly pinnatifid leaves.

Aliciella penstemonoides (Black Canyon gilia) is endemic to vertical cliff habitats that parallel the creeks and rivers of the Gunnison River Basin and headwaters of the Rio Grande (Figure 2). The stress-tolerant species is regionally rare, with large expanses of unsuitable habitat often separating populations. Yet within occupied sites, the perennial plant is locally abundant with morphological variation apparent both within and between populations (Figure 3). While it remains untested, it is hypothesized that local variation in geologic structure and diversity in surface heterogeneity drive selective pressures that result in the observed variation of morphology. Such variation may be an important mechanism for the species to adapt with the shifting climate.

The ongoing biodiversity crisis necessitates assessment of rare and endemic taxa so that we can recognize how global climate change influences species distributions and understand when local extirpations amount to global extinctions. Cliff ecosystems are poorly studied and are home to plant communities that receive comparatively lower levels of anthropogenic disturbance than communities in ►

Figure 1: The Painted Wall exemplifies the harsh and difficult-to-access habitat of *Aliciella penstemonoides* in the Black Canyon of the Gunnison. © 2016 Richie Hum

Figure 2: *Aliciella penstemonoides* at the Black Canyon of the Gunnison National Park. © 2016 Richie Hum

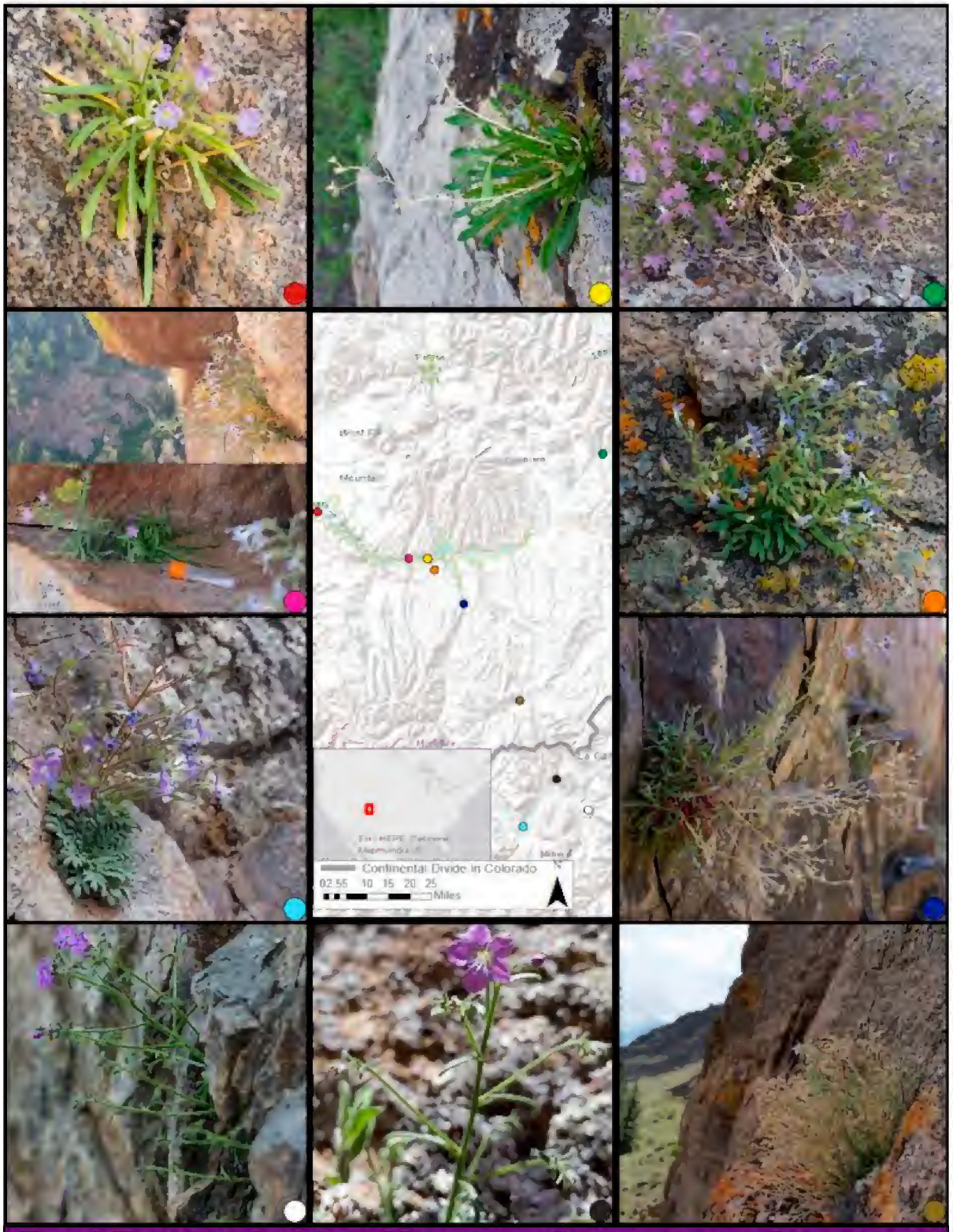


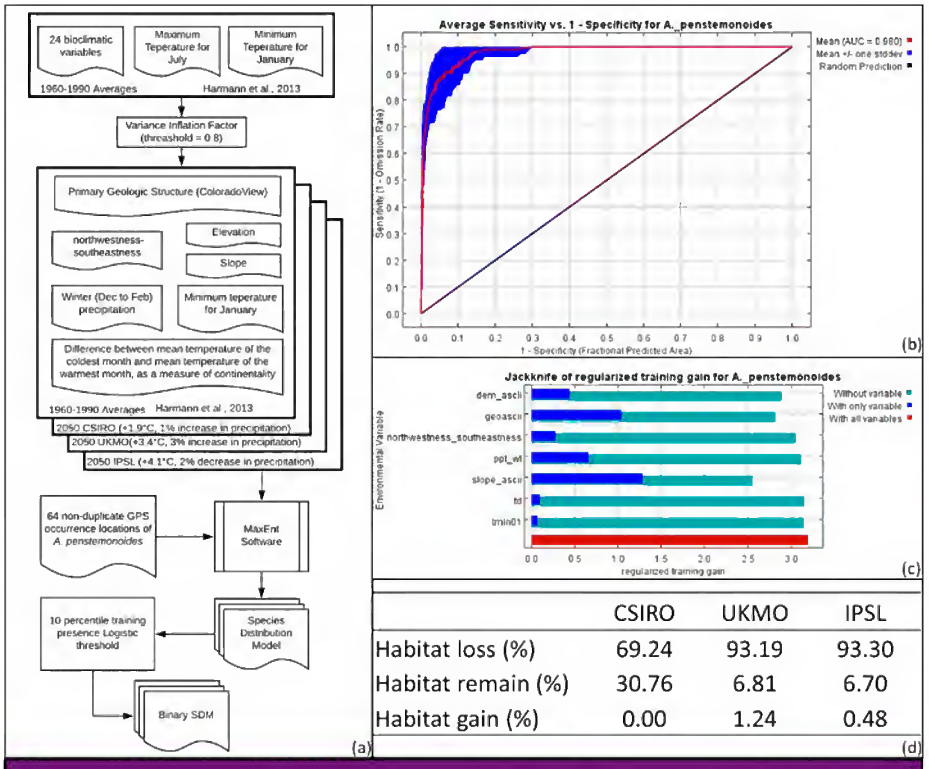
Figure 3: Morphological variations of *A. penstemonoides* across its range. Color points on map correspond to colored point in bottom right of subset images. © Richie Hum

◄ adjacent horizontal habitats. Research from the Cliff Ecology Lab at Appalachian State University has shown that glacial-relict plants are common refugees among Southern Appalachian cliff communities, as are rare and endemic disjunct taxa that are absent from the surrounding environment.[1] The vertical habitat provides relief from interspecific competition and favors stress-tolerant species.[2] Yet the extreme edaphoclimatic conditions imposed by the vertical habitat requires many obligatory chasmophytes (or species that exclusively dwell upon a cliff) to adapt morphological traits suitable for the harsh conditions.[3,4] As a result, the selective pressures for developing effective long-distance dispersal abilities are often ►

◄ inconsequential.[5] Obligatory chasmophytes thus act as potential bioindicators for determining the ability of regionally restricted stress-tolerant plants to withstand the velocity of climate change.

The velocity of climate change is a metric that describes the speed at which the climate moves across a point in space over time and can be used as an indicator for determining the speed at which a species range will need to shift to keep pace with the moving climate.[6] There appears to be a strong correlation between topographic slope and the velocity of temperature change, indicating that species inhabiting steep topographic regions require the slowest velocities of temperature change.[6] In other words, steep terrain provides a heterogeneous thermal environment (small changes up or down slope result in large temperature changes) in which species may track suitable climates by use of short-distance dispersal abilities. This contrasts with flat landscapes which maintain comparatively homogenous thermal environments and require species to travel greater distances to remain within the currently occupied climate.[7] Less than 10% of globally protected areas will maintain a climate with residence times exceeding 100 years, calling into question the efficacy of preserving rare and endemic plant species in protected lands under the threat of climate change.[6]

Understanding the vulnerability of a species to climate change can have a considerable influence on prioritizing conservation and management approaches that will benefit future generations. *Aliciella penstemonoides* is considered a vulnerable plant (global status of G3, Colorado state status of S3) because of its restricted range and limited number of occurrences.[8] Following field research in the summer of 2016, I identified 14 populations of *A. penstemonoides* and located over 2,000 individuals throughout Gunnison, Hinsdale, Mineral, and Montrose Counties.



	CSIRO	UKMO	IPSL
Habitat loss (%)	69.24	93.19	93.30
Habitat remain (%)	30.76	6.81	6.70
Habitat gain (%)	0.00	1.24	0.48

(d)

Figure 4: (a) Non-collinear bioclimatic variables were selected from a pool of two temperature variables and 24 bioclimatic variables following a variation inflation factor analysis. Variables representing topography and geology were added to the non-collinear climate variables to form the environmental predictors. Three projected climate scenarios of the same variables were also compiled. GPS occurrence locations were collected during field research in 2016. Occurrence locations and environmental predictors were input into the MaxEnt software to produce the species distribution models. (b) Model evaluation statistics averaged from 15 replicates and 25% sample records for testing. (c) Results of jackknife test of variable importance during model training. (d) Calculations that resulted from analyzing the overlap of suitable and non-suitable habitat between the current climate and three emission scenarios. © Richie Hum

To determine the effect that climate change may have on the Black Canyon gilia, I constructed a species distribution model (SDM) with MaxEnt software.[9] The environmental predictors consisted of topographic, geologic, and non-collinear bioclimatic layers (Figure 4a). One model (from 15 replicates) was created for the current climate (1960-1990), and three models for various socio-economic driven emission scenarios for a rapidly-growing economy fueled by a balance of fossil and non-fossil fuels.[10,11] After I converted the model outputs into binary SDMs to represent suitable versus unsuitable habitat, I calculated percent habitat loss, remain, and gain.

Test statistics showed the models to be robust, with slope contributing the most useful information to overall model performance (Figure 4b and 4c). Primary geologic structure contributed the second most useful information, followed by winter precipitation and elevation (Figure 4c). The projected climate scenarios suggest that the bioclimatic envelope currently occupied by *A. penstemonoides* is likely to shift within the next thirty years, and that it is unlikely that habitat expansion will occur (Figure 4d). It therefore appears that the Black Canyon gilia will be have a limited ability to migrate with ►

◄ the changing climate as the topographic and geologic variables are regionally restricted. For example, specific adaptations such as a deep growing root structures are suited for the joint cleavages or foliation fracture patterns typical of occupied sites are unsuitable for the pocketed rock in the West Elk Mountains and prevent the species from migrating to, or across, such sites.

The rapidly changing climate will require plants to either migrate to track suitable habitat, adapt to the novel environment within currently occupied sites, or become locally extirpated which may amount to global extinctions.[12]

While the models indicate that the Black Canyon gilia is likely to undergo a range contraction, a major limitation to the model is that large cliff systems often exhibit large thermal gradients and were not depicted within the spatial data. Cliff walls in the Black Canyon of the Gunnison National Park commonly reach over 600 vertical meters with the narrowest distance between the north and south rim being only 12 meters. The thermal and bioclimatic heterogeneity of the canyon was not investigated here, yet it may be possible for the small mucilaginous seeds of *A. penstemonoides*, which are light enough to be carried by the wind but adhere to water and soils that seep down along the cliff face, to allow for short distance migrations up or down the cliff to track suitable habitats. The models indicate that occupied sites within the BLCA may remain suitable under the three emission scenarios, suggesting that such locations will likely provide protection for the species over the next thirty years. Conversely, populations found on short cliff sites may not have the capacity for short-distance migration and are at a greater risk of extirpation if adaptation is unable to occur.

The observed morphological variation among populations of *A. penstemonoides* may be an important mechanism for species as populations are unlikely to undergo a range shift to keep pace with the velocity of climate change. Sites with low variation in rock surface heterogeneity revealed low levels of morphological variation within the population and may be at a greater risk of extirpation, especially if they occupy short cliff sites where there is little room for short-distance migration. Microsatellite primer pairs developed for *Ipomopsis aggregata* showed successful amplification of targeted loci in *A. penstemonoides* and could be used to provide estimates of ecologically important parameters (e.g., relatedness of individuals, local adaptation, and source-sink dynamics) that will allow land managers to develop conservation and management practices that align with the specie's historical adaptive abilities.[13]

Figure 5: The author finds access to the cluster of *Aliciella penstemonoides* seen in Figure 2 in the Black Canyon of the Gunnison National Park. © 2016 Kate Lis

Local extirpations of rare and endemic species are particularly concerning as such losses bring the species closer to a global extinction. If a rare species goes extinct, it is likely that other members of the community are also under the same pressures. The extinction of rare species decreases the biodiversity of the region and can have a negative influence on the ecological functioning of the community. The Gunnison River Basin is home to several endemic and rare taxa that exist in high stress arid habitats, an environment that will become more prevalent across the southwestern region as the climate continues to shift. It is possible that climate change will cause *A. penstemonoides* to go extinct within many of our lifetimes. Continued efforts to monitor the distribution and abundance of species such as the Black Canyon gilia will provide valuable evidence to explain the implications of climate change on large-scale ecological range shifts.

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"Aliciella penstemonoides …" continued on page 33 ►

News and Announcements

CSU Announces Endowment to Herbarium

Colorado State University in Fort Collins recently received an endowment of $158,000 from Charles L. and Ruth A. Maurer. The purpose of the Maurer endowment is multifold: To expand student participation in, improve, and grow the Charles Maurer Herbarium, as well as expand the user base. The endowment will be used to:

- Help grow the size of the Herbarium;
- Improve curation of specimens in the Herbarium;
- Improve facilities for users (including students, members of the general public, and online users) of the Herbarium;
- Support fieldwork by curators of the Herbarium as well as fieldwork by undergraduate and graduate students who contribute specimens from the regional flora to the Herbarium;
- Support undergraduate students who participate in the Charles Maurer Herbarium internship program; and
- Support outreach by students and curators of the Herbarium.

Charles is an active member of CoNPS and is a Native Plant Master® and NPM trainer. In 2015 he generously helped support publication of the first edition of assistant curator Jennifer Ackerfield's *Flora of Colorado*. He also generously funded a two-year floristics study by Madeline Maher on his family's land in southwestern Gunnison County, Colorado, as well as adjacent public land managed by the BLM. Madeline graduated with her MS in botany in December 2018.

Madeline Maher stands with Charles and Ruth Mauer at the family property in Gunnison County.

Charles and Ruth chose to provide a $158,000 endowment to the CSU Herbarium when they participated in Madeline's thesis defense in August 2018. In recognition of this endowment, the CSU Herbarium was officially re-named the Charles Maurer Herbarium in December.

Charles attended the Colorado School of Mines from 1956 to 1958. He transferred to CSU in 1958 and earned a BS in agronomy in 1961, followed by an MS in botany and plant pathology in 1963. Charles worked for Coors Brewing Company for nearly 30 years before retiring. He then worked for the EPA's National Enforcement Investigation Center at the federal center in Lakewood as a quality control consultant for 14 years.

Ruth attended CSU from 1957 to 1963. She earned a BS in physical science in 1961 and her an MS in mathematics in 1963. She earned her PhD in mineral economics (operations research and statistics) from Colorado School of Mines in 1978. Ruth taught in public schools for several years before working on her PhD. She is professor emerita in mathematical and computer sciences from Colorado School of Mines and she was a visiting professor at the US Military Academy at West Point for two years. Ruth also spent a sabbatical year teaching in northern Sweden. She has taught, and continues to teach, mathematics at several online universities since she retired from Colorado School of Mines.

2019 Event Calendar

(Please check the Events Calendar at https://CoNPS.org for updated information and registration.)

Committee Updates

Annual Conference Committee: Save the date!

The CoNPS Annual Conference is being held this year in Grand Junction, Colorado: September 28-29. The Rare Plant Technical Committee will meet the Friday before, September 27. Members wishing to help planning the Conference can contact Ann Grant, odygrant@gmail.com.

Strategic Planning Committee

The Strategic Plan for the Society is nearing completion. Once finalized, it will be available on the website so that members, Committees and Chapters can use as a guide for their activities.

Here are the Four Goals: the first three goals are derived from the CoNPS Mission statement.

Goal 1: Support the growth of new scientific knowledge
Goal 2: Share scientific knowledge and generate appreciation of native plants and habitats
Goal 3: Support conservation of native plants and habitats
Goal 4: Foster organizational sustainability

Horticulture Committee-Project BudBurst Colorado

We have been working on developing a statewide phenology project for Colorado native plants, Project BudBurst Colorado. We have chosen the national BudBurst project hosted by the Chicago Botanic Garden as an online platform. Plant data can be entered online or recorded off-line in the field and entered later. Our information becomes part of the BudBurst Project where researchers can download our anonymized results. The database can be searched by species, state, and growing zone. You can make observations in your own garden, rural, foothills or mountain property, or adopt a nearby park or open space. It's fun, it's easy, and the plants are beckoning.

This project replaces our previous project, Monitoring Native Plants in the Garden. If you already submitted data last year, don't worry, we have plans to input it to the new Project BudBurst Colorado. Contact conpsoffice@gmail.com for more information or to join the Project.

CoNPS Workshops

West Slope Workshop: Introduction to Colorado Wildflowers from Plains to Peaks

May 4; 9:00 AM - 12:30 PM
Fort Lewis College, Durango
Presenter: Mo Ewing

Become acquainted with the wonderful world of Colorado wildflowers and get started on developing skills to identify different species found in the Durango area. In the first section of our slide show, we will discuss how plants are named and identified, review basic plant morphology, and look at the characteristics of the 13 most common plant families. After a short break, attendees will take a virtual tour of the most common plants seen in Durango, the foothills, montane, subalpine, and alpine; identifying some of the most wonderful places to hike and what wildflowers you are likely to find there.

Mo Ewing is a retired Plant Ecologist with a MS in Conservation Biology from Antioch New England in New Hampshire. He is a CoNPS Board Member and is chairman of the conservation committee. He also volunteers in the research labs of Denver Botanic Gardens and the Colorado Natural Areas Program. Previously, he was the land stewardship director at Colorado Open Lands, a state-wide land trust. His interests range from mapping native plant communities to developing an interactive key to the moss genera of Colorado.

An Introduction to Colorado Mushrooms and Other Macrofungi

May 18; 9:00 AM - 3:00 PM
CU Biology Lab, Boulder
Presenter: Andrew Wilson

Discover the fascinating world of macrofungi—fungi that produce fruiting bodies that take the form of mushrooms, puffballs, cup fungi, corals, and more. Learn about their identification, diversity, biology, and the important roles they play in ecosystem health, ►

◄ from recycling organic matter in the soil to engaging in symbiotic interactions with plants and animals. This workshop will include anatomical studies of mushrooms from macroscopic and microscopic perspectives. Participants will be introduced to mushroom terminology as well as several resources for mushroom identification.

Andrew Wilson is the assistant curator of mycology at Denver Botanic Gardens. He began his career as a mycologist studying the diversity of macrofungi. Andy studied fungal taxonomy and morphology at San Francisco State University, and fungal evolutionary ecology at Clark University in Worcester, Massachusetts. As a postdoctoral researcher, Andy worked on the mushroom genus Laccaria *at Chicago Botanic Garden, and on the evolution of plant pathogenic rust fungi at Purdue University. In Colorado, Andy's work involves documenting the amazing diversity of macrofungi throughout the Southern Rocky Mountain Region using fungal taxonomy and systematic analysis of DNA sequence data.*

Vegetation Mapping and Land Management Decisions

May 31, 9:00 AM - 3:00 PM
Lookout Mountain Nature Center, Golden
Presenters: Irene Weber and Anthony Massaro

How do you describe a plant community? How do you describe a landscape? This workshop will discuss vegetation mapping using both quantitative and qualitative methods and how land management decisions can be made using that information. Topics covered include the purpose of mapping vegetation, vegetation classification systems, data collection systems, field methods, and translating data into action. The second half of the day will be in the field, weather permitting. This program is aimed primarily at professional botanists and land managers, but anyone interested in parks, environmental policy, or plant communities are welcome to attend.

Irene Weber is the senior botanist for Jefferson County Open Space. She has mapped vegetation across the US for the past decade and is currently working on mapping the 50,000-acre JeffCo Open Space system.

Anthony Massaro is a botanist for Jefferson County Open Space who has been mapping the JCOS system for the past five years. Anthony has been pioneering new data collection methods for the county and can make a mean GIS map.

Introduction to Front Range Wetlands Ecology Field Seminar

June 8, 8:00 AM - 3:00 PM
Natural Area in Fort Collins (Exact location will be sent to registrants)
Field Seminar Leader: Denise Culver

Explore the riparian and wetland areas along the Cache la Poudre. We will focus on plants and plant communities that have evolved to thrive in this habitat, as well as birds and mammals. This will be a leisurely stroll along the riparian corridor. It is designed for anyone curious about plant taxonomy, but we will also make sure that common names are used. The hike is 3-4 miles round trip with marginal elevation gain.

Denise Culver has been an ecologist/botanist with the Colorado Natural Heritage Program since 1995 and has worked in the ecology/botany field since 1987. Since 2008, she has designed and conducted numerous plant identification workshops for US EPA, USDI BLM, USDA Forest Service, Colorado Parks and Wildlife, and the Colorado Native Plant Society. She has been the project leader for over 32 Colorado county surveys for critical biological resources and is lead author for the Field Guide to Colorado's Wetland Plants: Identification, Ecology and Conservation; Common Wetland Plants of Colorado's Eastern Plains, Common Wetland Plants of Colorado's Southern Rocky Mountains, *and* Common Wetland Plants of Colorado's Western Slope, *as well as the* Colorado Wetland Mobile App.

Peripatetic Plant Ecology for All Field Seminar

June 22, 9:00 AM - 3:30 PM
Boulder OSMP (Exact location will be sent to registrants)
Leaders: David Buckner and Carla DeMasters

This field seminar will wander in space and subject in the City of Boulder OSMP grasslands, but all will relate to understanding the relationship of plants and plant communities to the environment (including other plants) as it exists now and as it has in the past. Participants will also intermittently engage in plant ID. Although the event will take place in the grasslands, other plant communities will make appearances in the discussions. Geomorphic and soil variation, along with aspect, slope, and animal interactions will all be allowed to tell their stories. The hike is an easy 2.6 miles with 150 feet elevation gain and is designed for all levels of knowledge and interest in grassland ecology/ecosystems.

Dr. David Buckner is a field plant ecologist with 50 years of experience. He has conducted workshops ►

◄ *for CoNPS on subjects including grass identification, sunflower family plant identification, soils, and landscape reconstruction since the early 1990's. David is an honorary lifetime member of CoNPS and has led many field trips for the Society.*

*Carla DeMasters has worked as an ecologist/botanist in the Western United States for over 15 years and currently works as a restoration ecologist with Westervelt Ecological Services. She has a MS in geography from CU Boulder and a second MS in biology from CU Denver. Her graduate research included exploring the effect of environmental factors on the distribution of prairie fleabane (*Erigeron strigosus*) at multiple scales using field investigations and GIS and testing eight annual/biennial species native to Colorado in a field competition study to determine their competitiveness with cheatgrass (*Bromus tectorum*). Carla is a certified ecological restoration practitioner with the Society for Ecological Restoration (SER) and a professional wetland scientist with the Society of Wetland Scientists. She is currently secretary on the board of the SER Rocky Mountain Chapter.*

Committee and Chapter Events

Browns Canyon BioBlitz

June 10-12
For more information, please contact Steve Olson, Field Studies Committee Co-Chair, at solson01@fs.fed.us

Field Studies: Eldorado Canyon Plant Inventory

July 20, 7:30 AM - 12:30 PM or beyond
Trip Leader: John Vickery

In preparation for a revision of the park's stewardship plan, Colorado Parks and Wildlife has invited the CoNPS Field Studies committee to assist in improving their knowledge of the plant species richness at Eldorado Canyon. This is an event coordinated by the CoNPS field studies committee.

Two sections of the park will be assessed: Inner Canyon and Crescent Meadows.

Members with advanced plant ID skills are needed to help others who may not be as skilled. The leadership team will do its best to accommodate all levels of botanical expertise. For example, beginner-to-intermediate level folks can follow closely along with trip leaders; advanced-to-expert level folks can botanize on their own in the immediate vicinity, or be a group of two to four individuals.
The group will compile a comprehensive plant list and will key plants out as needed. GPS units are encouraged for documenting plants of special interest (rare or uncommon native and nonnative plants).

A somewhat dated species list will be provided to registered participants in advance of event.

CoNPS members can contribute their plant list info from previous outings and years or from their own botanizing activities in 2019. Contact the trip leader John Vickery for more information jvickery@mcg.net. As the date nears, trip leaders will communicate with registrants regarding meeting site, assignments, and/or preferences.

See page 32 for John's biography.

Field Studies: Blue Mountain Plant Inventory

July 27, 7:30 AM - 3:00 PM
Trip Leaders: John Vickery (CoNPS field studies committee) and Anthony Massaro (Jefferson County Open Space)
Coal Creek Canyon Study Area is an undeveloped property owned by Jefferson County Open Space. This field studies event will help identify areas of high quality and potential sensitive or rare species, which will then be used to develop an adaptive management framework for the area. This event will have a focus on identifying flora species within water-associated habitat around Blue Mountain (a parcel at Coal Creek Canyon).

Boulder Chapter

City of Longmont St. Vrain Plant Inventory Event
August 3, 7:45 AM - noon
Leaders: Nate Schipper (City of Longmont) and John Vickery (CoNPS field studies committee)

The City of Longmont would like to inventory what plants are along the St. Vrain Creek before future construction takes place. This will aid in design plans for what species will get put back into seed mixes or plantings and identify any salvage opportunities. Join us in compiling a list of species for a 1.5 mile stretch of riparian habitat.

We are looking for a few folks with advanced plant ID skills to help others who may not be as skilled. We will do our best to accommodate all levels of botanical expertise. For example, beginner-to-intermediate level folks can follow closely along with trip leaders; advanced-to-expert level folks can botanize on their own in the immediate vicinity, or be a group leader if desired.

Metro-Denver Chapter

Chapter meeting: Growing Native Plants from Seed
May 14, 6:30 PM to 8:30 PM
Presenter: Jim Borland
Denver Botanic Gardens, Plant Society Building ►

◄ Northern Chapter

Chapter Meeting: West Horsetooth Field Botanical Surveys of 2018
May 7, 2019; 6:30 PM - 8:30 PM
Presenters: Zak Wiebe (Larimer County Natural Resources Department) and Susan Spackman Panjabi (botanist with the Colorado Natural Heritage Program).
Tamasag Event Center, Bellvue CO

The surveys addressed the County's three newly acquired parcels of land adjacent to Horsetooth Mountain Park and possible impacts on native flora and fauna.

River's Edge Natural Area Planting Event
May 11, 9:00 AM - 12:00 PM
Point of Contact: Kathy Maher
CoNPS volunteers will help guide volunteers to dig, plant, and weed at the City of Loveland's River's Edge Natural Area in Loveland. Volunteers from the general public will be planting native grasses and forbs. CoNPS members may choose from a variety of roles to help ensure the job is done correctly and educate volunteers along the way.

Choose your role from any or all of the following:
- Demonstrate proper planting procedures and techniques;
- Assist/mentor/supervise members of the public and middle-schoolers doing the planting;
- Educate volunteers on species being planted (plant lists provided in advance);
- Educate volunteers on hows and whys of attracting pollinators, soil health, habitats, native plant communities, you-name-it;
- Weed identification, weeding techniques (there will be weeds to pull!);
- Independent QC: Check that planted specimens are at correct depth, straight, watered in, and weed-free for 18" radius.

If few volunteers show, get your hands dirty planting specimens yourself!

Plateau Chapter

May 18: Visit the CoNPS booth at the 3rd Annual CSU Extension Demonstration Day from 9:00 AM to 1:00 PM. Meet with many organizations and green industry people involved in the Plant World at 2775 Hwy 50 in Grand Junction.

August 3: Susan Carter, co-president of the Plateau Chapter, will speak at the Montrose Botanic Gardens on using Native Plants in the Landscape. More details TBD.

Southeast Chapter

Chapter Meeting: Cacti
May 2, 6:00 PM – 8:00 PM
Contact: ecocitycoloradosprings@gmail.com

Meeting includes review of upcoming programs, discussion of Native Plant Sale at Colorado Springs site.

Chapter Meeting: Fossil Flora of CO
August 1, 6:00 PM – 8:00 PM

CoNPS Board Meetings:
Anyone can attend the society's board meetings.

Saturdays, 10 am to 1 pm;
August 17 and November 16

Boulder County Fairgrounds, Longmont

CoNPS 2019 Chapter Field Trips

CoNPS 2019 Chapter Field Trips

CoNPS chapters are in the process of scheduling field trips for the upcoming season. To register for these trips and others yet to be announced, visit www.conps.org, sign in as a member, navigate to the calendar of events, and click on the date of the event you want to attend.

Boulder Chapter Field Trips

May 15:	Wandering Botanist Hike at Joder Ranch Trail with Pat Butler
Jun 9:	Plant Hike in Morgan County Sandhills Ranchland with John Vickery and Bruce Bosley
Jun 15:	Plains Meets Foothills, by Carrie Cimo
Jul 17:	Niwot Ridge with Pat Butler
Jul 21:	Mountain Butterflies and their Plants with Venice Kelly

Metro-Denver Chapter Field Trips

May 5:	Pattridge Open Space with John Vickery
May 7:	Riverside Cemetery with Cheryl Ames
May 11:	Aurora Reservoir with Byron James
May 21:	Willow Creek Trail in Roxborough
Jun 5:	Sandstone Ranch, south of Castle Rock with Heather Koch and Elizabeth Taylor
Jun 9:	North Table Mountain with Tom Schweich
Jun 15:	Kendrick Lake Garden Tour with Jim Borland
Jun 16:	Plant Inventory - Reynolds Park, Jefferson County Open Space with John Vickery ►

◀Jun 17: Lost Creek Trail with Kelly Ambler
Jun 22: Beaver Brook Trail with Jim Borland
Jun 25: Staunton State Park with Lenore Mitchell
Jul 9: Loveland Pass Lakes with Kelly Ambler
Jul 12: Willow Creek Fen with Steve Yarbrough
Jul 13: Shrine Ridge Trail with Sue Janssen
Aug 10: Golden Gate Canyon State Park with Judy King
Sep 7: Aurora Reservoir with Byron James and Joy Thompson

Northern Chapter Field Trips
May 11: River's Edge #2 Planting Event
May 16: Black Powder Trail in Gateway Natural Area with Ann Grant
May 23: Halligan Reservoir Area Private Land with Cindy and Bill Henk
Jun 1: Red Mountain Open Space with Ronda Koski
Jun 13: Twin Owls, Lumpy Ridge with Lauri Paulic
Jun 23: North Fork of Big Thompson Rive with Laurie Paulic
Jun 29: Tunnel Creek in Rawah Wilderness with Hugh Mackay

Southeast Chapter Field Trips
May 14: Garden of the Gods with Maggie Gaddis
May 15: Wildflower Wednesday at Cheyenne Mountain State Park with Pat Cooper
May 25: University Park Open Space and Pulpit Rock Regional Park with Dan Follett
Jun 18: Garden of the Gods with Maggie Gaddis
Jun 20: Elk Park for Pikes Peak Alpines with Doris Drisgill
Jul 5: Cottonwood Pass Alpines with Doris Drisgill
Jul 13: Shrine Ridge Wildflower Hike with Sue Janssen
Jul 13: Buffalo Canyon for Woodlilies with Doris Drisgill
Jul 27: Red Rock Canyon Open Space with Curt Nimz
Jul 30: Garden of the Gods with Maggie Gaddis
Aug 10: Independence Pass Alpines with Doris Drisgill
Aug 17: Florissant Fossil Beds with Tom Green
Aug 22: Garden of the Gods with Maggie Gaddis
Sep 24: Garden of the Gods with Maggie Gaddis

Cross-Pollination Events

Colorado Wilderness Conference

May 10 - 11
Buena Vista, CO

Volunteers, staff, and wilderness lovers will meet to discuss the state's most pressing wilderness topics such as new designations, current management strategies, and grassroots organizing skills.
https://www.cmc.org/wild

American Penstemon Society Annual Meeting

May 31 - June 3
Walden, CO

The American Penstemon Society will host its 2019 annual meeting in northwest Colorado May 31 to June 3. Registration is limited. The meeting includes multiple field trips to see penstemons near North Park, Kremmling, and State Bridge. Habitats visited will include sagebrush steppes, sand dunes, fens, montane and subalpine forests. Evenings will feature lectures in Walden.

APS advertises that there will be opportunity to see the following penstemon species: *P. cyanthophorus, P. saxosorum, P. rydbergii, P. radicosus* (potentially), *P. virens, P. harringtonii, P. ousterhoutii,* and *P. penlandii* (if permission is granted by landowner).

For more information, visit
http://penstemons.org/index.php/annual-meetings

Earth Corp Field Studies Course

July 8-28, April 12 application deadline
Sangre de Cristo Mountains

Earth Corps students will complete environmental restoration projects in Willow Lake Basin located at the base of Challenger Point and Kit Carson Peak, two iconic 14,000-foot peaks in the Sangre de Cristo Mountains, and develop key outdoor skills during the program and through their summits of both peaks. The projects entail long hours of very demanding physical labor at altitudes of 11,000-14,000+ feet. Students will learn and practice outdoor leadership, Leave-No-Trace ethics, backcountry navigation, alpine mountaineering, and risk management skills. For more information, visit
https://www.rmfi.org/civicrm/event/info?id=1825

15th Biennial Conference of Science & Management on the Colorado Plateau & Southwest Region

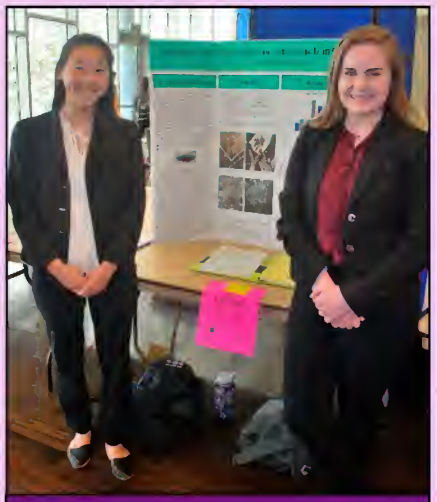
September 9-12, 2019
Northern Arizona University

This conference creates an important opportunity to identify possible responses to challenges such as climate change, energy development, and habitat alteration that negatively affect the natural and cultural landscapes of the Southwest.
https://in.nau.edu/biennial-conference-of-science-management/

Students Honored at State-wide Science Fair

The annual state-wide science fair was held at Colorado State University April 11. CoNPS judges were CoNPS northern chapter members Renee Galeano-Popp, Alice Guthrie, and Jim Gano. They awarded the senior division prize to Monarch High School students Laura Zhang and Brooke Newell for their project "Impact of *Rhinocyllus conicus* on a Native Thistle on the Colorado Front Range." The two students looked at the effects of this biocontrol for musk thistle on *Cirsium canescens*. The junior division prize went to Hazel Cleaves of St. Columba Catholic School for her project "Rooted," during which she compared the effectiveness of western wheat, little bluestem, and blue grama to mitigate soil erosion. Each student was awarded $50 from CoNPS.

Galiano-Popp said that they considered 20 entries this year, an increase from four years ago when CoNPS first started judging there. "The hope is that by giving awards from CoNPS, teachers will take note and encourage students to do a study on native plants or ecosystems."



Laura Zhang and Brooke Newell and their prize-winning presentation.

Little Woman

by Arthur Clifford

Blue Eyed Mary stands in a bonnet of green
Her lips of blue fill the spaces between

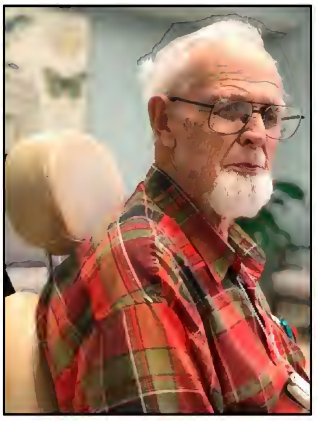
Diminutive you are in the glade of the mountain
Making your home near the waters of its fountain

She looks out across the flow through the meadow
Collinsia parviflora carpet exceedingly shallow

Tiny maiden you have nothing to regret
The merit of your small flower
Befits the epithet

Blue-eyed Mary, *Collinsia parviflora*, at 9,200' elevation. © Kelly Ambler

In Memorium: Dexter Hess



By Fran Pannebaker

Dr. Dexter Winfield Hess was one of the founding members of CoNPS. He was on the faculty at Otero Junior College in La Junta, CO. After his retirement, Dexter volunteered at Bent's Old Fort NHS for over two decades. From 1975 to 1993 he collected 145 plant specimens to start the park's herbarium collection. Over those 20 years, he trained multiple seasonal and park staff in plant identification and plant collection methods. Dexter was generous with his knowledge and his time. He could out walk and out work people many years his junior. Southeastern Colorado heat didn't bother him. Mosquitoes didn't bother him. Rattlesnakes didn't bother him.

In 1994 Dexter advised park staff, creating a long-term monitoring program which predated the NPS Inventory and Monitoring Program by at least a decade. His hand-drawn map of the plant communities was extremely accurate when compared to the GIS/GPS maps created by the NPS I&M program. His map will be in the park archives in perpetuity.

Member Profiles: Aquilegia's Volunteer Newsletter Staff

Kelly Ambler, associate editor for design and layout of *Aquilegia* since Fall 2017, has always loved the natural world and has tried to learn about it as much as possible. "The world opened up for me when I was 9 or 10 and discovered that animals and plants could be studied for their own sake, not only for human purposes," said Kelly, an epiphany that set her on a path to becoming a scientist. Kelly performed her doctoral studies at the University of California, San Diego, where there are abundant opportunities to experience different ecosystems. Kelly has been a CoNPS member since 2012 and last year became a Colorado Native Plant Master®. Hard-pressed to pick a favorite plant, she says "I am quite delighted when I come across gentians, which often bloom long past other plants."

Nan H. Daniels, proofreader since 2015 and occasional author, is a retired GIS Analyst whose work brought her into the realm of rangeland health and wildland restoration in the early 2000s. Professional colleagues, plus the CO Weed Management Assn., Ft. Collins Gardens on Spring Creek and her mother's membership in the New Mexico Native Plant Society, began to involve her in CoNPS. With partner Curt Cole, Nan has been a volunteer steward for a two-section Colorado Natural Area in Park County since 2007, and she earned her Native Plant Master through the Larimer County CSU Extension in 2013. For the northern chapter of CoNPS, she's on the leadership team and monitors the Loveland Open Lands Advisory Commission. Nan is also a past Board member (2010-13) and serves on the conservation committee. A long-time gardener, she looks forward to working with the CoNPS Project Budburst this year, plus continuing with photography, hiking and quilting projects, and volunteering with GOSC.

Mary Menz, managing editor since Fall 2017, is an award-winning writer and editor. In 2014, she earned the Native Plant Master® designation from CSU Extension. She joined CoNPS shortly thereafter. Until 2016, she taught the NPM course in Teller County and now co-teaches the course for the Tri-Rivers Area on the Western Slope. She lives in Ridgway and especially loves hiking and flower-finding in the alpine zone. Mary advocates for native plants in the landscapes of neighbors, friends, and anyone who listens by encouraging them to consider the benefits to native pollinators and birds. She is also a certified naturalist and master birder and has volunteered annually since 2011 as a banding assistant at various migratory banding stations.

Cathi Schramm is new to CoNPS and the proofreading staff of *Aquilegia*, joining both in 2018. Her love of wildflowers goes way back, though, kindled during long walks in the woods and bogs of Cockburn Island in Lake Huron, and growing ever since. She has carried that passion from Michigan to Indiana to Lakewood, Colorado, where she lives her partner, teenage daughters, and newly planted garden of natives. She recently completed an MA in Conservation Biology, has begun Native Plant Master courses through CSU Extension, and volunteers with the Urban Prairies Project as a Restoration Master Volunteer. In her day job she works as a technical writer and instructional designer, and is looking to shift her career in a direction that will use her skills to preserve and restore our fragile ecosystems.

Linda Smith retired from CSU Extension in El Paso County in 2008. While employed with Extension, she developed the publication *Identification Key for Woody Plants of the Pikes Peak Region* using materials she created from teaching plant identification to the El Paso County Master Gardeners. This publication was used on a state-wide level for MG training, and in the horticulture programs at Front Range Community College in Westminster and CSU in Fort Collins. She also helped set up the Native Plant Master® Program in El Paso County and taught one of the first sessions at the Garden of the Gods in 2008. For the past 11 years, Linda has been the part-time administrative coordinator for CoNPS. As part of her duties, she is a proofreader for *Aquilegia* and sends out the biweekly eNews. Linda also volunteers for CoNPS as a member of the Horticulture Committee and as Co-Chair of the Conservation Committee. She's in the process of developing a CoNPS coloring book, posters, and greeting cards with botanical art of native plants. She enjoys spending quality time with her family and partner, Michael, and photography, travel, art, and birdwatching.

Elizabeth Taylor is a volunteer proofreader for *Aquilegia*. Although her father was a botany professor for over 40 years, much to his dismay, she pursued college degrees and a career in zoology, wildlife management, and technical communication. It was not until she retired seven years ago that she renewed her childhood fascination with plants. ►

◀ Now she is a Native Plant Master®, an NPM instructor, a volunteer naturalist for both Douglas Land Conservancy and Douglas County Open Spaces, and a member of the Board of Directors of DLC. She will be co-teaching an NPM class at Sandstone Ranch, Douglas County's newest Open Space, in May 2019 and will be co-leading a CoNPS fieldtrip to that same location in June.

John Vickery, proofreader, is a conservation ecologist by training who currently works in land stewardship services such as weed management, restoration planting, and erosion control. He serves on three CoNPS committees: education & outreach, field studies (FSC), and conservation. Through FSC, the Denver & Boulder Chapters and other auspices, he organizes and leads or participates in field trips, plant inventory activities and BioBlitzes. In the past, John was active with the Native Plant Master® Program and conducted field classes through Boulder County Extension. Currently, he serves on the Public Affairs Committee of the Weed Science Society of America and the Editorial Board of the Natural Areas Journal.

◀ "Native Enough…" *continued from page 12*

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Narango, D.L., D.W. Tallamy, and P.P. Marra. 2018. "Nonnative plants reduce population growth of an insectivorous bird." *Proc Natl Acad Sci USA.* 115:11549-11554.

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◀ "Hummingbirds…" *continued from page 4*

tubular flowers (e.g., roses, geraniums) are attractive and lure birds in, but don't produce enough nectar to keep hummingbirds in the area long.

- Choose flowers that bloom at different times to provide nectar throughout the season.
- When possible, select native varieties for your garden. Many cultivated varieties have lower nectar production than native plants. Avoid invasive plants that may escape to neighboring woodlands or other areas that have native plant species.
- Include fuzzy plants (e.g., pussy willow), because hummingbirds use the soft fibers in their nests.
- Avoid the use of pesticides and insecticides when possible, so that the garden provides a good place to forage for insects and nectar. Both pesticides and insecticides can accumulate in insects and nectar.
- You can also add other attractants, such as a hummingbird feeder on a shepherd's hook or a hummingbird fountain.

Reprinted by permission from the authors who presented the information at a joint meeting of the Montrose Botanical Society and the Black Canyon Audubon Society in 2017. *Examples of native species attractive to hummingbirds include* Monarda *spp.,* Lonicera involucrata, Asclepias spp., Aquilegia spp., Castilleja spp., Chamerion angustifolium, Ipomopsis aggregata *and* Penstomen spp. *MM*

About the photographer

CoNPS member Marlene Borneman is author of *The Best Front Range Wildflower Hikes* pack guide and co-author of *Rocky Mountain Wildflowers*, a Colorado Mountain Club pack guide by CMC Press. She is lives in Estes Park.

Black twinberry honeysuckle (*Lonicera involucrata)* features a twin yellow tubular flowers and twin black berries later in the season. Common along the Front Range and Western Slope at 6,000-11,000.'
© Marlene Borneman

◀ "Two Wildflowers…" *continued from page 15*

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More Cross-Pollinating Events

May 17
Endangered Species Day

May 31-June 9
Nebraska Wildflower Week

June 14-16
Wyoming Native Plant Society Annual Meeting
www.wynps.org/activities/

June 20-24
Eriogonum Society Annual Meeting
http://www.eriogonum.org

June 21-23
Montana Native Plant Society Annual Meeting
http://www.mtnativeplants.org/annual-meetings/

July 27-31
Botanical Society of America Conference
https://botany.org/

August 2-4
Native Plant Society of New Mexico Annual Conference
https://www.npsnm.org/events/2019-annual-conference/

August 31 - September 1
Arizona Botany Annual Meeting
http://www.aznps.com/Happenings/CurrentHap.pdf

◀ "*Aliciella penstemonoides …*" *continued from page 23*

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Richie Hum recently graduated with a Master's Degree from the Cliff Ecology Lab at Appalachian State University where he continues to work as a Lab Manager while looking for a place to continue his education. You can reach him at richie.hum@gmail.com.

The author thanks the Myrna P. Steinkamp Memorial Fund of the Colorado Native Plant Society and Appalachian State University for providing funding toward this research. He also thanks Dr. Mike Madritch, Dr. Gary Walker, Kate Lis, and Daniel Rigney for assisting in field research.

CoNPS Membership

Name_____
Address _____
City _____ State_____ Zip_____
Phone _____
E-mail_____
Chapter (if known) _____

CHAPTERS: Boulder, Metro-Denver, Northern (Ft. Collins-Greeley), Plateau (Grand Junction & West Slope), Southeast (Colorado Springs-Pueblo), Southwest (Durango) or Unaffiliated

If this is a change in address, please write your old address here.
Address _____
City _____ State_____ Zip_____

☐ **Check box to receive information on volunteer opportunities**

DUES include *Aquilegia* newsletter, published quarterly.

The 36-page, full color electronic publication arrives by PDF in member email boxes in February, May, August, and November. Black-and-white copies can be mailed to members without email addresses.

Membership dues cover a 12-month period.

□ New □ Renewal

□ Student $17 □ Senior (65+) $17 □ Individual $25
□ Family $35 □ Plant Lover $50 □ Supporting $100
□ Patron $250 □ Benefactor $500 □ Life Member $800

CONTRIBUTIONS to CoNPS are tax deductible:

John Marr fund for research on the biology and natural history of Colorado native plants $ _____

Myrna P. Steinkamp Memorial fund for research and other activities to benefit the rare plants of Colorado $ _____

Total included: $ _____

Please make check payable to:
Colorado Native Plant Society

Send completed form and full remittance to:
CoNPS Office
PO Box 200
Fort Collins, CO 80522

You may also join online at
https://conps.org/mfm-join-page/

Make Your Garden a Certified Native Plant Garden

CoNPS now has a Certified Native Plant Garden Program. Showcase your native garden with a sign that helps create awareness in your neighborhood. A CoNPS Certified Native Garden--

- Meets specific criteria demonstrating the applicant's dedication to providing habitat for Colorado's diverse ecosystems through the seasons.
- Honors gardeners for their commitment, planning, and hard work to provide habitat for Colorado Native Plants and native wildlife.
- Contributes to the growth of healthy, diverse, and resilient ecosystems in our neighborhoods by spreading the word about CoNPS and Native Plants.

If you're interested in having your garden become a CoNPS Certified Native Plant Garden, request an application by email at conpsgarden@gmail.com

Answers (clockwise from top left): ***Stellaria sp.,*** starwort, Caryophyllaceae family. ***Gentianella acuta***, dwarf gentian with crab spider, Gentianaceae family. ***Mitella pentandra***, alpine miterwort, Saxifragaceae family. ***Mitella stauropetala***, white miterwort, Saxifragaceae family. ***Gentiana prostrata***, Siberian or pygmy gentian, Gentianaceae family. ***Paxistima myrsinites***, mountain lover, Celastraceae family. All photos © Jay Austin

Can You ID these Tiny Flowers?

Colorado Native Plant Society
P.O. Box 200
Fort Collins, Colorado 80522
http://www.conps.org

Save the Date!

2019 Annual Conference is September 27-29

The Rare Plant Symposium is Friday, September 27TH. The 43rd CoNPS Annual Conference is Saturday, September 28TH. On Sunday, September 29TH, there will be several options for field trips in the Grand Junction Area.

The conference theme is:
"The Ever-changing Landscape."

Congratulations to the 2019 CoNPS Grant Recipients!

Justin Bain: "Understanding how the floral nutrient landscape influences bee foraging, pollination, and the structure of plant-pollinator interaction networks."

Emily Lockard: "Use of native plants in a production orchard to enhance ecological systems."

Isabel Schroeter: "The role of plant physiological thresholds and resource use strategies in riparian ecosystem recovery in Rocky Mountain National Park."

Emily Schumaker: "Where in the world is *Eriogonum umbellatum*? Using ecological niche modeling and genetic analysis to determine support for varietal separation."

Denise Wilson: "Monitoring *Epipactis gigantea* Populations Within Plots Subjected to Three Canada Thistle Eradication Methods."

Epipactis gigantea. © Kelly Ambler